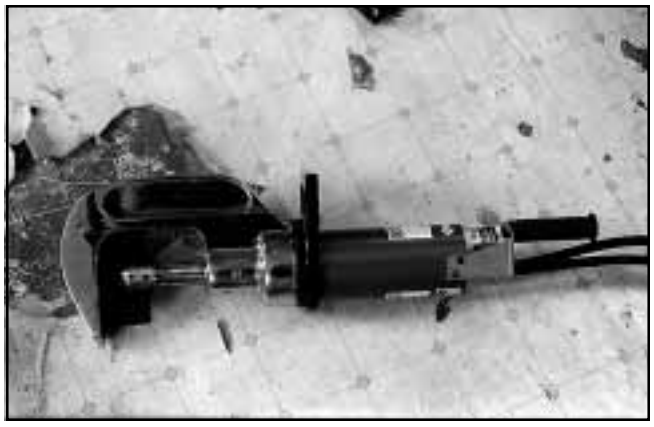
Deactivation and Decommissioning Focus Area

QUARTERLY REPORT – OCTOBER 1999

July – September 1999 Activities



Science & Technology

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D&D Focus Area

On the Cover: clockwise from upper left.

Size Reduction Machine being demonstrated at the Savannah River Site 321 M LSDDP.

The **Mega-Tech Blade Plunging Cutter** is scheduled for demonstration in the LANL LSDDP at the FIU-HCET.

Demonstrated at the Mound Plant to solidify tritiated pump oils, the **NOCHAR® Petro Bond** is a high quality polimer specifically designed as a petroleum-based liquid absorbant.

The **Bosch 1125VSRH, a 24-Volt, battery-operated, BE rotary hammer drill** was demonstrated in September of 1999 at the Idaho National Engineering and Environmental Laboratory.

The purpose of this document is to provide an overview of the Deactivation and Decommissioning (D&D) Focus Area and to update readers on the program's current activities. It presents a synopsis of the current program status and recent accomplishments, along with overviews of planned activities, program issues, and opportunities. Quarterly reports are distributed to U.S. Department of Energy (DOE) headquarters and operations office managers, site personnel, site operating contractors, technology developers, principal investigators, regulators, and other stakeholders. Issued in January, April, July, and October, the D&D quarterly reports summarize the activities of each preceding quarter. The D&D Update is published in all other months, introducing new projects and highlighting advances in ongoing projects. Quarterly reports, monthly updates, and further information about the D&D Focus Area (DDFA) are found on the World Wide Web at *www.netl.doe.gov/dd*. Technologies are usually identified by their discrete tracking numbers within the Technology Management System (TMS) operated by DOE's Office of Science and Technology (OST). Providing access to information about OST programs, technologies, and linkages to EM problems, TMS is found on the World Wide Web at *ost.em.doe.gov/tms/home/entry.asp*.

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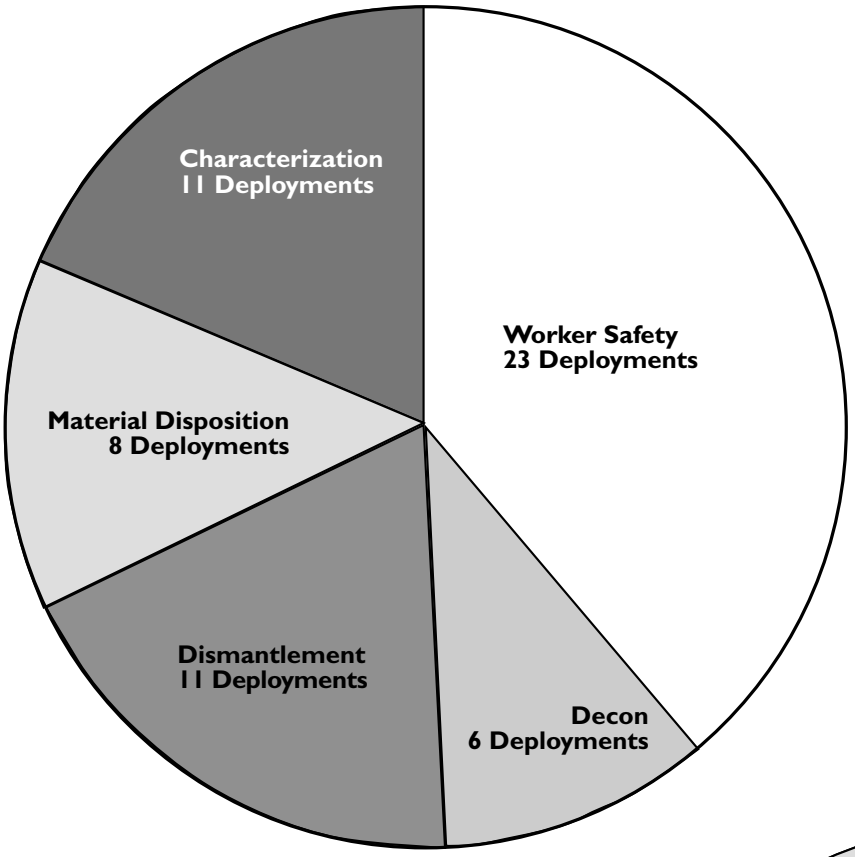

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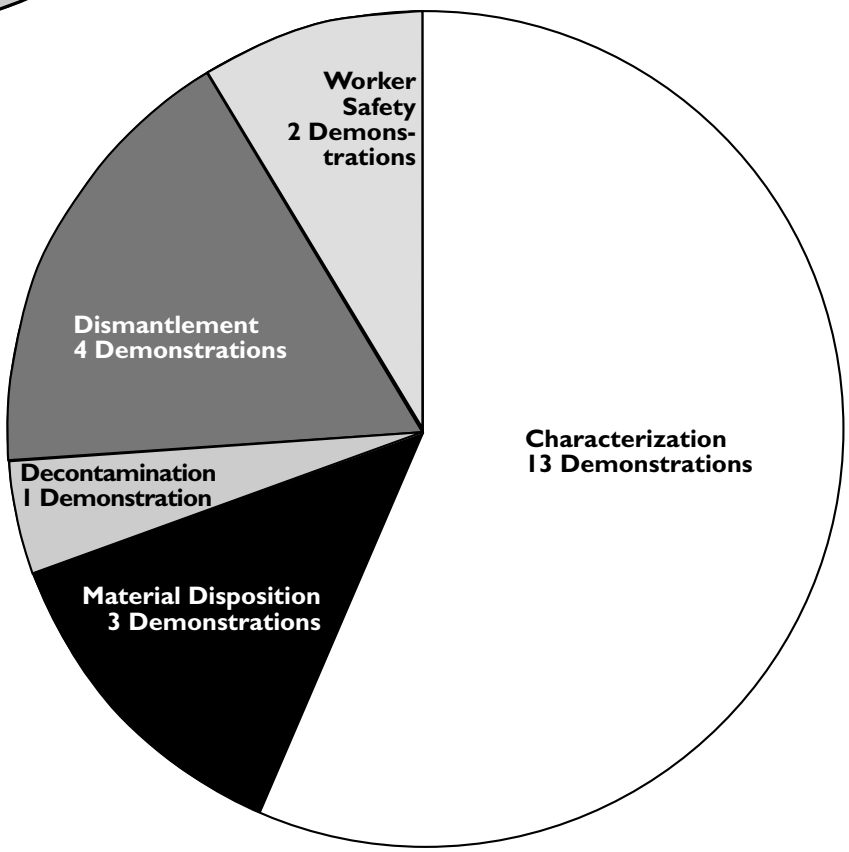

1.0 HIGHLIGHTS

Savannah River LSDDP Completes Final Demonstration

The Size Reduction Machine (TMS #2395) was demonstrated at the Savannah River Site (SRS) Fuel Fabrication Facility Deactivation LSDDP in the first week of September. It was demonstrated on both loose and overhead items. The loose items consisted of standard and rolling chairs and stainless steel carts. The overhead items included a plant and instrument air system with 1½-in. carbon steel schedule 40 piping, ¾-in. condensate piping, and an overhead lift rack consisting of 3-in by 3-in angle, support rods, and a unistrut trolley/rail system. Baseline technologies used in comparison were a gasoline powered hydraulic ResQ hand held shear and standard hand held portable band saw. Benefits identified from the demonstration included similar speed in cuts/hour to the baseline, less fatigue to operators, increased safety by removing operator's from harm's way, and faster cutting times for larger items than the baseline. The Size Reduction Machine is a hydraulic shear mounted on a manually moved platform. The platform is a hydraulic/mechanical assist device that takes the weight of the shear off the operator. This device will shear items six inches below floor level to 15 feet above, and will cut within two inches of the wall or floor surface.

Completion of this demonstration brings the technology demonstration portion of the SRS LSDDP to a close. A total of five technologies were demonstrated. These technologies, besides the one discussed above, included strippable coatings, TMS #2314; long-range alpha detection, TMS #2382; electret ion chambers, TMS #2315; and portable x-ray k-edge fluorescence, TMS #134. The final portion of the SRS LSDDP will be the submittal of the remaining innovative technology summary reports and the SRS LSDDP final report.

For more information:

http://www.srs.gov

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The Size Reduction Machine is a hydraulic shear mounted on a manually moved platform. The platform is a hydraulic/mechanical assist device that takes the weight of the shear off the operator.

2.0 Project Summary Table

The following table summarizes the Technical Task Plans for the D&D Focus Area Core Program and related Crosscutting and Industry Program contracts. Project descriptions follow in subsections 2.1 through 2.5 and are organized by the work breakdown structure (WBS) element listed here.

Project Number	D&D WBS Element	Project Name	Page
AL08DD21	Demonstrations and Industry Approaches	Large-Scale Demonstration: Los Alamos National Laboratory Transuranic Waste	6
OH08DD21	Demonstrations and Industry Approaches	Large-Scale Demonstration: Mound Tritium Facilities	7
SR08DD21	Demonstrations and Industry Approaches	Large-Scale Demonstration: Savannah River Site 321-M Fuel Fabrication Facility	9
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DE-AC26-99 FT40555	Demonstrations and Industry Approaches	3-D Gamma Ray Imaging Technology	13
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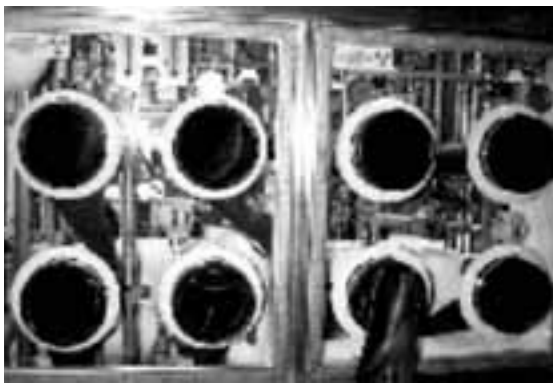
2.1 Demonstration and Industry Approaches

LANL TRU Waste Characterization, Decontamination, and Disposition LSDDP



Objective and Scope: The scope of this LSDDP is to demonstrate improved or innovative technologies for the characterization, decontamination, segregation, volume reduction, packaging, and preparation of transuranic (TRU) waste currently in storage at the Los Alamos National Laboratory (LANL) disposal facility at TA-54 and destined for permanent disposal at the Waste Isolation Pilot Plant (WIPP). LANL currently has 1,500 m^3 of TRU waste in inventory—313 plutonium-contaminated glove boxes in a 24,000 ft^2 facility—and expects to generate another 2,500 m^3 from ongoing operations in coming years.

The LANL LSDDP selected five technologies for demonstration in 1999. These five technologies are the AeroGo air pallets, the SAIC Vehicle and Cargo Inspection System for RTR of crates, the Mobile Characterization Services transportable X-Ray for RTR of crates, the NUKEM RASP for sectioning gloveboxes, and the Mega-Tech hydraulic cutter.

Current Reporting Period Activities: The first two demonstrations were executed in June, both providing convincing information on the desirability of the technologies. The AeroGo air pallets proved to be the only viable and accurate method for moving and positioning the crates in the Large Item Neutron Counter (LINC). Additional data will be obtained when the purchased air pallets are used. The VACIS Demonstration was successful in proving that the gamma interrogation techniques could identify the contents of the crates. A total of 46 crates or other truckload scans were taken during the demonstration showing excellent identification of equipment, filters, and dense trash.

The third demonstration, for an X-Ray interrogation of crates, is under subcontract and project plans are well underway. The demonstration location has been selected and the Health and Safety Plan is in review. A fourth demonstration, Mega-Tech cutting of glovebox legs, is planned for a demonstration in the middle of September 1999.

Activities planned for the next two months are to complete the AeroGo demonstration and initiate the reporting, to complete the VACIS vehicle and cargo inspection system Innovative Technology Summary Report, to execute the demonstration of the Mobile Characterization System large crate X-Ray system, and to execute the Mega-Tech demonstration of hydraulic glovebox leg cutting. The Mega-Tech demonstration and completion of the AeroGo demonstration will be carried out in late September. The Mobile Characterization System demonstration will be in early October.

Due to the inadequate fire protection at TA-54, radiological work will be transferred to a permanent structure that is currently being built. In the interim, all demo's associated with the LANL LSDDP will be postponed. Once the permanent building is complete demonstrations will resume.

Bottom view of the AeroGo pad at the LANL LSDDP.

For more information:

http://www-emtd.lanl.gov/LSDDP/DDtech.html

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Mound Tritium D&D LSDDP

Objective and Scope: The Mound Plant in Miamisburg, Ohio began operations in 1948. The site's mission, originally to fabricate the neutron initiator for the atomic bomb, expanded to include research, development,

and production of numerous nuclear and non-nuclear weapons components, production of radioisotopically fueled thermoelectric generators, and surveillance of nuclear weapons components.

The objective of the Mound Tritium D&D LSDDP is to identify, demonstrate, and evaluate innovative technologies applicable to the decontamination and decommissioning (D&D) of tritium facilities. D&D of Mound's surplus tritium facilities, the T and R/SW Buildings, provides a unique opportunity to compare, evaluate, and eventually execute innovative D&D technologies alongside baseline technologies in an ongoing project. The Mound LSDDP will identify and explore methods to improve worker safety while achieving cost and schedule savings. The project is expected to identify technologies that, when implemented in the Mound LSDDP, will produce significant savings on the $57.8 million baseline. The results and successes of this demonstration project will benefit similar DOE facilities and projects.

The Technical (T) Building is an underground reinforced-concrete structure built in 1948 for the purification of polonium-210 used in nuclear weapons initiators. Later the facility was used to extract other radionuclides, house the plutonium verification facility, and store TRU materials. Facilities large enough to handle multikilogram quantities of tritium were added to the building. Current plans are to decontaminate T Building to potentially allow unrestricted public reuse by the year 2003. The SW Complex and one corridor of rooms in the adjacent R Building form the SW/R Complex. Four types of operations have been performed in these facilities to support nuclear weapons programs using tritium: component development, component evaluation operations, tritium recovery, and material analysis. To meet DOE's vision of completing the environmental restoration of the site by 2005, the SW/R Tritium Facilities will be demolished, and contamination beneath the building will be removed.

It is anticipated that innovative technologies will be applied to the following decontamination tasks:

1. tritium-contaminated gloveboxes
2. tritium characterization techniques
3. productivity improvement technologies
4. tritium specialties decontamination
5. piping system removal and disposition
6. mixed waste treatment and disposal
7. tritiated water treatment
8. contaminated water plume under SW building
9. miscellaneous rad/non-rad traditional building materials disposition

The Mound LSDDP IC Team includes Babcock & Wilcox of Ohio, Lawrence Livermore Laboratory (LLNL), British Nuclear Fuels Limited (BNFL), Foster Wheeler, IT Corp, LANL, Westinghouse Savannah River, Princeton Plasma Physics Laboratory (PPPL) and Florida International University.

Current Reporting Period Activities:
In the third quarter of 1999, this project completed the three demonstrations that were initiated in the previous quarter. The first of these demonstrations was of the Lumi-Scint 1000 Portable Liquid Scintillation Counter. The Lumi-Scint 1000 Portable Liquid Scintillation Counter is a portable version of the baseline liquid scintillation counter that can be easily transported to survey field sites. A dry smear of a 100 square centimeter area of a surface, in this case a tritium-contaminated surface, is taken and placed directly into a vial containing a liquid scintillation "cocktail." The vial is then placed in the Lumi-Scint 1000 for immediate counting, eliminating the need to transfer the smears to a laboratory for measurement by a large immobile liquid scintillation counter. The Lumi-Scint technology proved very easy to use for detection of tritium on contaminated surfaces during demonstration. The technology proved to be accurate for counting the beta activity produced from tritium for large variations of activity. Use of a single photo multiplier tube presented no problems for using the instrument for measuring tritium. The Lumi-Scint tracked consistently against the baseline contamination swipe readings over the course of the demonstration. The instrument saved time when used for non-routine surveys/ monitoring. Radiological Control Technician's feedback about the quick turn-around time, portability, and ease of use was very positive. By taking the Lumi-Scint to the source of activity, the user can obtain a significant reduction in time and labor requirements over the baseline technology.

The Lumi-Scint 1000 Portable Liquid Scintillation Counter

The second demonstration completed during the third quarter was the Waterworks SP-400. Waterworks SP-400 is a polymer-based absorbent that can be used to solidify aqueous waste. It is similar to other polymer-based absorbents that offer benefits over traditional solidification agents such as cement or the Mound facility baseline solidification agent Aquaset. Benefits include a high liquid to absorbent ratio, no mechanical mixing is required to promote the absorption process, there is little to no volume increase in the waste form after addition of the absorbent, and a very high retention in the form of the gel-like material. The Waterworks SP-400 was demonstrated at the WD Building Addition Room 110 to demonstrate its absorbent properties in solidifying tritiated water.

A total of five 55 gallon drums of wastewater using the polymer were prepared along with four drums using the Aquaset material. With the baseline absorbent, four 50-pound bags of Aquaset are added to 40 gallons of water in the 55-gallon drum. The Waterworks SP-400 is able to immobilize water at a relatively high weight ratio of water to absorbent. Earlier phases of this demonstration using non-radioactive water identified a weight ratio of 50:1 as a conservative formulation. With this ratio, the Waterworks was able to immobilize 53 gallons of water per 55-gallon drum with only 8.8 pounds of Waterworks crystals. The labor costs for the respective operations are about the same although the operators were enthused about adding 8+ pounds of absorbent instead of having to manually handle four 50-pound bags to accomplish the same task. The cost of the absorbent per gallon of water absorbed favors the polymer by nearly 4 to 1.

The NOCHAR Petrobond® demonstration for solidification of tritium-contaminated pump oils has been completed. NOCHAR Petrobond® crystals are a high-quality polymer offered by NOCHAR®, Inc., of Indianapolis, Indiana, and are specifically designed as a petroleum-based liquid absorbent. The ability to absorb liquids has been around for many years, but has never been considered as an acceptable solidification platform because absorbed volumes were high and subject to separation. The Petro-bond® absorbs very quickly with little inrease in volume. The Petro Bond can be used for free-liquid control in storage, transport, and disposal of low-level radioactive waste. The Mound demonstration was conducted in three phases with non-radioactive RCRA oil used in a number of

bench tests during Phase I, clean oil as adapted to a DOT certified shipping package in phase II, and tritium contaminated RCRA oil solidified in a 22 gallon DOT shipping container in phase III. In all phases of the demonstration, the agent formed an acceptable solidified mass with RCRA waste oils. The Toxicity Characteristics Leaching Procedure (TCLP) values were found to be several magnitudes below burial site limits on specified metals. The product proved very easy to use and required no agitation or mixing, thus facilitating safety and As Low As Reasonably Possible (ALARA). The material absorbed the six gallons of oil used in the demonstration within one hour, providing a quick and efficient solidification agent. In a restrictive environment that will not allow for mixing and/or other typical solidification steps, this technology would prove to be ideal. The product proved to be safe, easy to use, and cost effective and has the potential to produce considerable savings over other disposal options.

For more information:

http://www.doe-md.gov/lsdd/lsdd.htm

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▼321-M Fuel Fabrication Facility Deactivation LSDDP

Objective and Scope: The deactivation of Savannah River Site's 321-M Fuel Fabrication Facility is the first LSDDP the Deactivation and Decommissioning Focus Area (DDFA) is sponsoring with the Office of Nuclear Material and Facility Stabilization. This 60,000-ft^2 facility currently has small quantities of highly enriched uranium reactor fuel material that requires special control and accountability. Once the material is removed and the deactivation is complete, the facility will be much less expensive to maintain. Five innovative and improved technologies will be demonstrated in key areas, including characterization, decontamination, dismantlement, and waste management. The potential cost savings and mortgage reductions are estimated to be $20 million.

The IC Team for this project includes representatives from Florida International University, the U.S. Army Corps of Engineers, Duke Engineering and Services, Westinghouse Savannah River Company, and Bechtel National-Oak Ridge.

Status and Accomplishments: The following technologies have been demonstrated as part of the SRS 321-M Fuel Fabrication Facility Deactivation LSDDP.

- Long-Range Alpha Detector (TMS #2382)
- X-Ray K-Edge Heavy Metal Detection System (TMS #134)
- Strippable Coatings (TMS #2314)
- Size Reduction Machine (TMS #2395)
- Electret Ion Chamber (TMS #2315)

Current Reporting Period Activities: The Savannah River Site completed its final technology demonstration this quarter (See Highlight in Section 1.0).

For more information:

http://www.srs.gov

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▼INEEL Fuel Storage Canals and Associated Facilities LSDDP

Objective and Scope: The Idaho National Engineering and Environmental Laboratory (INEEL) Fuel Storage Canals and Associated Facilities LSDDP is led by an IC Team consisting of Parsons Engineering, BNFL, Lockheed Martin Idaho Technologies Company, TLG Engineering, Florida International University, and Idaho State University. This LSDDP will utilize funding, technologies, and expertise from the Offices of Environmental Restoration, Science and Technology, and Nuclear Material and Facility Stabilization; industries; universities; and the international community.

The project includes the following areas:

- *Test Reactor Area (TRA)-660,* housing two underwater research reactors, the Advanced Reactor Measurement Facility and the Coupled Fast Reactivity Measurement Facility with a 30,000-gal interconnecting water canal that was sometimes used for fuel storage. These facilities were utilized for reactivity insertion experiments that were later scaled up for experiment design in larger reactors. The two reactors achieved criticality in 1960 and 1962, respectively. Neither has operated since February 1991. Contamination includes radioactive elements, lead, and chromium.
- *TRA Filter Pit system*, consisting of five structures containing large filters associated with test reactor operations. The facilities are contaminated with lead, radioisotopes, and deteriorating asbestos. The filters are located in restricted entry pits, and work will have to be done remotely and in confined spaces.
- *Test Area North (TAN)-620 Initial Engine Test Control Room*, a massive underground, shielded, heavily reinforced concrete structure that served as the control center for the engine tests in the Aircraft Nuclear Propulsion Program conducted at the INEEL in the late 1950's and 1960's. Contamination includes asbestos, mercury, lead, and some potential radiation.

Eleven to 18 innovative and improved technologies will be demonstrated in the areas of underwater inspection, characterization, and dismantlement; inspection, characterization, and dismantlement in restricted spaces; recycle of materials from D&D activities; removal of loose radiological contamination on walls, floors, piping, and equipment; removal of fixed radiological contamination on concrete; tank, vessel, and piping decontamination; lead plate radiological decontamination; and high-radiation exposure fields.

This LSDDP is a high priority for the DOE/Commercial Nuclear Utilities D&D Consortium, with demonstrated technologies having deployment opportunities in the nuclear utility market through the consortium. Resulting deployments throughout the DOE complex alone could generate a potential cost savings and mortgage reduction of $20 million.

Current Reporting Period Activities: At the close of fiscal year 1999, the IC Team had selected a total of 21 technologies for demonstration from 135 technologies screened. These are remote underwater characterization systems (RUCS) for reactor pool inspections; soft-sided containers for disposal of low-level D&D waste; an automatic locking scaffolding system; a lead paint analyzer; a Robotic Climber with a scabbler (En-Vac); an Alloy

Analyzer; a PCB Analyzer; an Electromagnetic Radiography (EMR) instrument; a Portable Safety Monitor (PSM); an In-Situ Object Counting System for "free release" of decontaminated areas (IFR); a Copper Wire Recycle System; Paint Scaler; Global Positioning Radiometric Scanner (GPRS); Electro-Chemical Decontamination System named CYGNUS; 3-Dimensional Surface Mapping System called 3D UKRobotics; Roughing Filter Technology by Advanced Nuclear Pre-Filter (ANAP); and Integrated Vertical and Overhead Decontamination System (IVODS). Three technologies that were once approved for demonstration were cancelled due to scheduling or budgetary constraints and one technology that was approved for demonstration was combined with an already approved technology (En-Vac Corner Scabbler with En-Vac Wall Scabbler) for a current total of 17 technologies that are planned to be demonstrated or have been demonstrated during the INEEL LSDDP.

Of these, eight have been demonstrated and nine are planned to be demonstrated in fiscal year 2000. The RUCS was demonstrated in August 1998 and has been deployed at an additional application at INEEL. The soft-sided containers were demonstrated from August 1998 through January 1999. The soft-side containers are now being deployed at all D&D sites at INEEL and are now considered baseline technology. The lead paint analyzer was demonstrated on February 9, 1999. The automatic locking scaffold system was demonstrated from January 18, 1999 to April 9, 1999. This technology has now been deployed at a number of sites at INEEL. The EMR demonstration was completed on June 28, 1999, and the Alloy Analyzer demonstration was completed on June 29, 1999. The PCB Analyzer demonstration was started on June 2, 1999, with the collection of samples for both the baseline and new technologies.

The Paint Scaler Technology was demonstrated September 22, 1999, and the GPRS was demonstrated on September 29, 1999. The Paint Scaler Technology obtained samples 5 times faster than the baseline technology. The INEEL workers plan to continue using the Paint Scaler to obtain paint samples. The GPRS was used to provide 100 percent coverage of gamma radiation characterization of large areas such as contaminated soils around a facility. The detection equipment is mounted on four-wheel drive HUMV and includes a global positioning system, computer and software, and two plastic scintillators. The system provides radiometric data (in counts per second), geographical data (latitude and longitude), altitude, and time. The baseline is gridded hand-held surveys. The demonstration took place over an old trench where a lightly contaminated stack was filled and covered with soil as a radiological barrier. The area was surveyed with the baseline and considered to be within release limits. When the GPRS went over the same area it identified an area of subsidence with slightly elevated radiation levels above background. As a result of this demonstration that area will be backfilled and resurveyed. The IC Team is actively pursuing additional technologies for demonstration for fiscal year 2000.

For more information:

http://id.inel.gov/lsddp/

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▼Canyon Disposition Initiative

Objective and Scope: The Hanford Canyon Disposition Initiative (CDI) Project is a collaborative project that includes participation across the DOE Office of Environmental Management (EM). Participating EM offices include the Office of Waste Management, the Office of Environmental Restoration, the Office of Science and Technology, and the Office of Nuclear Material and Facility Stabilization. This partnership is driven by the broad and significant impact that decisions made on the disposition of the canyons will have to all of these programs.

The CDI Project is evaluating the feasibility of using the five chemical processing facilities (canyons) as assets for disposal of low-level wastes, instead of a mortgage liability to the Environmental Restoration (ER) Program. The U Plant facility is being used as a pilot for this evaluation. The U. S. DOE, Richland Operations Office (RL) ER Program signed an Agreement in Principle with the regulators at the beginning of FY 1997, to conduct the evaluation for the disposition alternatives for the canyon facilities. In 1996, a Canyon Task Team of personnel from RL, the U.S. Environmental Protection Agency, and the Washington State Department of Ecology(known as the Tri-Parties) conducted a series of workshops to identify an approach for the long-term disposition of the five main processing facilities in the 200 Area (B Plant, T Plant, U Plant, Plutonium Uranium Extraction Facility, and the Reduction Oxidation Plant) at the Hanford Site. The assessment made by the Canyon Task Team centered on the possibilities of removing the processing facilities, leaving all or part of the facilities in place and identifying alternative beneficial uses for the facilities. The team concluded that the technical approach for dispositioning any of the facilities could be bounded by the following six alternatives:

- Alternative 0: No Action
- Alternative 1: Full Removal and Disposal
- Alternative 2: Decontaminate and Leave in Place
- Alternative 3: Entombment with Internal Waste Disposal
- Alternative 4: Entombment with Internal/ External Waste Disposal
- Alternative 5: Close in-Place—Standing Structure
- Alternative 6: Close in-Place—Collapsed Structure

The Record of Decision for the 221-U Facility will generate regulatory and technical precedence for future disposition of the other four remaining processing facilities.

Current Reporting Period Activities: A Liquid Detection vendor was selected (Infrared) in past reporting periods and began and completed their fieldwork. After comprehensively analyzing data collected during the initial two weeks of the demonstration, Infrared returned and completed their full scope of work. The Infrared images to determine liquid levels in tanks and piping systems are being analyzed and incorporated into an Innovative Technology Summary Report.

AIL Systems, Inc. completed the demonstration of the new 3-D gamma and visual imaging system. The equipment was used on the canyon deck and inside several process cells. Images were captured at various aspect angles and are being rendered in 3 dimensions.

In August and September 1999, the project deployed the Andros robot in the railroad tunnel within the 221-U facility. This deployment was an operational test of the Andros vehicle in preparation for the more difficult characterization of the 750-ft. ventilation tunnel located in the 221-U facility. Access to the tunnel is through a 3-foot by 3-foot chimney, which requires the robot to curl up and then extend its arm and equipment once inside the tunnel. The Andros robot was successfully deployed on Wednesday, September 8, 1999. The robot, equipped with two

camera and lighting systems, a gross gamma detector, smear sample pads, and two gamma spectroscopy sensors was lowered by crane into the tunnel. Two additional camera and lighting systems were deployed into the tunnel on the robot's lifting platform. The robot spent more than five hours in the tunnel and traveled the length of the 750-foot tunnel collecting detailed video of the structure, smear samples, and radiation readings. The robot was successfully removed from the tunnel and was not severely contaminated. The robot will, therefore, be available for future missions. No obstructions or visual structural problems were identified in the tunnel.

3-D Gamma Ray Imaging Technology

Objective and Scope: The objective of the Phase I effort is to comprehensively demonstrate an improved 3-D Visual and Gamma Imaging System, as part of the Canyon Disposition Initiative (CDI) characterization project. Demonstration of the 3-D system is to be of sufficient scope such that definitive data/information will be generated to thoroughly compare the technical performance, cost, and other benefits of the system [3-D] to other visual and gamma imaging technologies/systems. Results of the technology demonstration are to be succinctly reported and widely communicated throughout the DOE complex. The ultimate goals of this effort are: (1) to support the characterization project objectives of the CDI, and (2) to facilitate deployment of 3-D Visual and Gamma Imaging technology.

The objective of the Phase II effort is to perform actual characterization-related D&D of contaminated facilities in the DOE complex, and describe the potential deployment services to be completed.

Current Reporting Period Activities: The AIL PHOTOMODELER™ 3D Visual and Gamma-Ray Imaging System was successfully demonstrated at the Hanford Site 221-U facility as part of the CDI. Measurements were taken of canyon equipment from several viewing directions using the PHOTO-MODELER camera. The combined radiation and visual date were rendered as 3-D drawings that allow the user to view the representation from any angle. The gamma-ray sources are color-coded to represent the radiation intensities. The known coordinates and intensities of the sources allow calculations of dose estimates to be performed for any position relative to canyon equipment. These positional and intensity data allow better dose mapping in the canyon area that should improve planning decision-making, with respect to the goals of the CDI.

For more information:

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Demonstration of the Infrared-based Liquid Level Detection (LLD) technology as part of the Canyon Disposition Initiative.

Non-Intrusive Liquid Level Detection

Objective and Scope: The objective of the Phase I effort is to demonstrate a Non-Intrusive Liquid Level Detection Technology (NLLDT) as part of the Canyon Disposition Initiative (CDI) characterization program. Demonstration of the NLLDT system is to be of sufficient scope such that definitive data/information are generated to thoroughly compare the technical performance, cost, and other benefits of the system to Hanford's baseline technologies/methods for detecting liquid levels in tanks and other vessels, and in piping systems. Results of the technology demonstration are to be succinctly reported and widely communicated throughout the DOE complex, and beyond. The ultimate goals are of this effort are: (1) to support the characterization project objectives of the CDI, and

(2) to acilitate deployment of the NLLDT—should the system prove advantageous.

The object of the Phase II effort is to perform actual characterization-related D&D of contaminated facilities in the DOE complex, and describes the potential deployment services to be completed.

Current Reporting Period Activities: Demonstration of the technology was recently completed at the 221-U facility at the Hanford site, as part of the CDI project. The NLLDT employs infrared cameras to detect very small temperature variations in materials. Subsequently, the emitted heat is converted into a visible dynamic TV-like picture (thermogram). For decommissioning projects, the NLLDT can be used to remotely locate liquids in vessels and piping systems, while providing optimum safety for workers. Mobilization/setup of the NLLDT is more than an order of magnitude faster than the baseline method of physical inspection/hot-tapping, and it costs from 5 to 10 times less that than the baseline technology.

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TMS #2403

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http://www.bhi-erc.com/canyon/canyon.htm

TMS #2178

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Highly Selective Nuclide Removal System—Accelerated Site Technology Deployment

Objective and Scope: In 1992, the last of the five U.S. Department of Energy production reactors at Savannah River Site (SRS) was placed into shutdown mode, with no intention to restart. With this action, the site entered into an extensive deactivation and long-term surveillance and maintenance life-cycle phase of these facilities. The integrity of the aging facilities has become a concern in recent years. Large volumes of contaminated water exist at some of these facilities at SRS (for example, fuel storage, and disassembly basins). Treatment of this water requires removal of the water from the basin and shipment to the F and H Area Effluent Treatment Facility (ETF). A technology that is cost-effective and safe is needed to process the basin waters on location and selectively remove radioactive materials without transporting the water to the ETF. The technology must reduce targeted nuclides to near DOE release limits and condition the water for direct release. Efforts to address these concerns have been initiated under the current funding for reactor monitoring and are being incorporated into the overall facility deactivation, decontamination and decommissioning planning strategy. With the uncertainty of the basin integrity over time, a technology that can remove radioactive contamination from the basin water while minimizing secondary waste generation is essential to the success of the deactivation of the DOE reactor basins.

The Savannah River Site Accelerated Site Technology Deployment will deploy an innovative, highly effective water treatment system to remove selected radionuclides from millions of gallons of water. Overall, deactivation and decommissioning life-cycle costs are expected to be significantly lowered via deployment of the technology.

Status and Accomplishments: Deployment of the NURES technology by Selion Technologies Inc., a selective and highly efficient ion exchange technology will remove cesium-137 (Cs-137) and strontium-90 (Sr-90) from over 5 million gallons of the R-Reactor Disassembly Basin water, while drastically reducing secondary waste volumes. This

deployment will be its first at a DOE site, but additional deployments are anticipated, since the equipment can readily be relocated. Savannah River will also partner with the 3M Company with a deployment of their highly selective Cs-137 ion-exchange removal system. The 3M technology, (a membrane support system known as EMPORE) will also be deployed in the R-Reactor Disassembly Basin to remove Cs-137 and Sr-90.

To date, a deployment plan has been prepared and deployment of both the 3M and NURES technology is expected in FY 2000. The 3M EMPORE membrane system is on site at SRS and undergoing system checks prior to installation at R-Basin. Deployment of the 3M EMPORE system is expected in the first quarter of FY 2000.

For more information:

TMS #2937

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Mobile Work Platform—Accelerated Site Technology Deployment

Objective and Scope: This ASTD project involves a partnership between the Fernald Environmental Management Project (FEMP) and Idaho National Environmental and Engineering Laboratory (INEEL) to purchase and deploy a Mobile Work Platform (MWP) at Fernald and Idaho and potentially at other DOE Sites including Hanford, Rocky Flats, and the Savannah River Site.

Five major complexes Plants 7, 4, 1, Boiler, and 9 at the FEMP site have been successfully decontaminated and decommissioned (D&D) during the course of ongoing environmental restoration activities pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Major complexes, (Plant 2, Plant 8, and the Pilot Plant) will undergo D&D activities in FY 2001 and FY 2002. In addition to the FEMP facilities, the INEEL Test Area North - Building 616 has also been identified as a deployment location.

To address the Sites' needs, Fernald and Idaho will develop a common specification and then purchase a MWP that satisfies both Sites' needs.

Status and Accomplishments: While the FEMP achieved cost and schedule improvements with each successive D&D project, the D&D of the major projects were expensive and labor intensive. Of particular concern during past, present and future D&D projects is the removal of "process" piping. Removal of process piping presents two concerns. The first is a personnel safety concern. The workers, impaired by several layers of personal protective clothing and a full face respirator, have to handle power tools while working off the ground on ladders, scaffolding and/or man-lifts. The second concern is the close proximity, within inches, that the workers have to be to a radiation/contamination source (process pipe). This concern has been formally documented at the FEMP by the Site Technology Coordination Group (STCG), Need Number OH-F010, "Safe and Efficient Process Piping and Conduit Dismantlement." This is the highest priority of Fernald's documented D&D needs. Use of a MWP will remove the workers from the immediate industrial hazard and radiation/contamination zone, which will significantly increasing the safety of the pipe/conduit removal process.

A Deployment Plan has been written and issued. Detailed requirements and specifications are being developed. Operator training and initial deployment will be completed by the end of FY00.

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▼Remote Size Reduction for Large Hot Cell Deactivation—Accelerated Site Technology Deployment

Objective and Scope: The 324 Building, located at the Hanford Site near Richland, Washington, is being deactivated to meet state and federal clean up commitments. The 324 Building has several highly radioactive tanks, tank vaults, piping, and large hot cells containing complex chemical processing equipment. To meet the clean up commitments, there is a need to deploy more rapid and remote size-reduction, debris collection and removal, characterization, and decontamination methods. Readily deployable deactivation methods that reduce worker exposure, secondary waste generation, costs, and risks are also needed. Deployment of a remote/robot work platform in the 324 B-Cell with full reach capabilities will significantly accelerate work tasks; eliminate the need for multiple, specialized tool design and procurement; and reduce the overall program risks.

The Hanford Site ASTD project will fund the deployment of a robot work platform to support 324 B-Cell clean up activities. Through this project, Hanford will procure and deploy a remote/robot work platform that is positioned with an overhead crane to perform deactivation activities. Following B-Cell cleanup, the work platform will be deployable for other 324 and Hanford site cleanup missions.

Status and Accomplishments: A crane-supported remote/robot work platform that can perform deactivation tasks in a radioactive environment is required. Tasks will include metal cutting, debris retrieval and packaging, small equipment relocation, floor cleaning, visual inspection, characterization, and decontamination activities. Use of this remote/robot work platform will reduce worker exposure and programmatic risk, and provide project cost and schedule savings.

A Deployment Plan has been written and issued. Detailed requirements and specifications are being developed and a request for proposal has been sent out. Platform delivery is expected in FY00. Installation, operator training, and initial deployment will be completed by the end of FY00. Critical response dates are as follows:

- Last date to submit written questions—November 5, 1999
- Vendor responses (proposals) due —November 19, 1999
- Anticipated contract award—on or about December 17, 1999.

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▼Surface Contamination Monitor—Accelerated Site Technology Deployment

Objective and Scope: The objective and scope of this Nevada Test Site (NTS), Accelerated Site Technology Deployment (ASTD) project is to deploy a Surface Contamination Monitor and Survey Information Management System (SCM/SIMS) from Shonka Research Associates (SRA). The SCM/SIMS will be deployed at the Test Cell C facility, which was used for testing nuclear rocket reactors. The facility has a large exterior concrete pad and interior floor spacing requiring survey. The SCM/SIMS will be used for the characterization of concrete floors in order to expedite survey and closure at a reduced cost and risk. Use of SCM/SIMS is expected to be extremely beneficial in characterizing the Test Cell C facility, and is expected to be deployed at other NTS facilities including the Pluto facility.

Status and Accomplishments: NTS developed its Project Execution Plan and Field Instructions in anticipation of the survey effort. A contract was also let to Millennium Services to deploy the SCM/SIMS during the third week of October 1999. The deployment is scheduled to coincide with the Technology Information Exchange (TIE) conference in Las Vegas, and is planned as part of the D&D field trip for conference attendees.

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Los Alamos National Lab (DVRS) – Accelerated Site Technology Deployment

Objective and Scope: In cooperation with DOE/EM/OST (EM-50), the DOE-Albuquerque Field Office has assembled a team to resolve the DOE complex-wide problem of oversized metallic TRU waste disposal. Their mission, being to provide advanced proven technology in pursuit of OST and the Accelerated Site Technology Deployment (ASTD) goals, the team will deploy a fully integrated relocateable Decontamination and Volume Reduction System (DVRS) initially at Los Alamos National Laboratory (LANL) and ultimately at other DOE sites. The Albuquerque DVRS Industrial team consists of representatives from the DOE Los Alamos Area Office (LAAO) and Los Alamos National Laboratory with prime contractor Nuclear Fuel Services, Inc., its subcontractors BNFL Instruments, Inc., MAC Corporation, Merrick and Co., and NFS-Radiation Protection Services, Inc., an affiliate company of NFS, Inc.

The DVRS has been deployed successfully in a multijurisdictional regulatory environment at the Nuclear Fuel Services-Naval Fuel Fabricating Facility in Erwin, Tennessee, where more than 680 m^3 of TRU waste were processed. After processing, the TRU waste was shipped to Oak Ridge National Laboratory for interim storage, eventually recovering, packaging, and returning to DOE more than 8 kilograms of plutonium and 38 kilograms of uranium.

Providing the capability to process and dispose of approximately 2400 m^3 of oversized metallic TRU waste currently in storage at TA-54 at Los Alamos within a substantially reduced operating period, the Albuquerque DVRS Industrial Partners will deliver the system to Los Alamos under a guaranteed fixed-price contract, ready for installation and operation 12 months after receipt of contract award. The majority of this TRU waste (currently non-certifiable in its present packaging configuration) will be processed to Low Level Waste, and thus, cost effectively be compacted and disposed of onsite. Aside from existing waste volumes, it is anticipated that the DVRS will be deployed to process an additional 3000 m^3 of similar waste resulting from on-site D&D activities at other Los Alamos facility upgrade activities. These upgrade activities are essential to the Laboratory's role in stockpile stewardship.

Status and Accomplishments: Because of a 2-hour fire rating (which requires that a fire inside the structure be contained within the structure for 2 hours), it was decided that refurbishment of the LSDDP dome and ASTD dome would be more costly and extend the schedule more than construction of a new metal building (i.e., Butler building) that would house both the LSDDP and ASTD DVRS projects. The design of the Butler building has started, and the DVRS is expected to be operational inside the building in June 2000, which is about 11 months behind schedule. The Butler building will be located about 100 feet from the existing ASTD DVRS dome.

For more information:

TMS #2242

http://www-emtd.lanl.gov/LSDDP/DDtech.html

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Oversize Transuranic (TRU) Waste Laser Cutting System at the Nevada Test Site—Accelerated Site Technology Deployment

Objective and Scope: Deploy a laser cutting system at DOE/NV to reduce the size the TRU waste not decontaminated so that it fits in the WIPP shipping containers, and also deploy the laser cutting system to Hanford and Rocky Flats to size-reduce TRU waste so that it can be containerized and shipped to the WIPP. DOE-NV has a need to size-reduce and characterize 58 oversized TRU contaminated metal boxes (total volume of 270 cubic meters) prior to shipping them to the WIPP. The contents of these boxes are contaminated glove boxes (32), a metal cutting lathe, lengths of metal piping, lengths of angle iron, and various scrap metal. The Hanford material requiring size reduction includes a minimum of 150 glove boxes (there are also ductwork and piping). There is actually much more material to be processed, but the economics in this proposal are based on 150. And at Rocky Flats, the laser cutting system will also be applied to contaminated glove boxes (proposal is based on 150).

Status and Accomplishments: The initial deployment is expected to be occur at the Los Alamos National Laboratory (LANL) due to schedule complications at the Nevada Test Site. DOE-NV is seeking an agreement to deploy the laser cutting system at the LANL during FY 2000. The location at LANL is to be in the Los Alamos Technical Area 54, where the Decontamination and Volume Reduction System (DVRS) ASTD facility is now under construction. Materials to be size-reduced include stainless steel glove boxes and other large metal items. Radioactive contamination levels of these materials are TRU and low level. The deployment will also be coordinated with the ongoing LANL TRU Waste Characterization Decontamination and Disposition Large-Scale Demonstration and Deployment Project. As soon as the agreement is in place, the laser and associated equipment will be ordered through the equipment integrating contractor, GSI Lumonics. This will include the following:

1. Industrial 2 kW Nd/YAG laser with chiller, fiber-optic cable, and end-effector;
2. Customized trailer containing the laser, the laser chiller, and the cutting control station;
3. Two pedestal-mounted industrial-type robotic arms with anti-contamination sleeves (one arm holds the laser end-effector and the other arm holds the item being cut);
4. Rotational cutting table and grippers; and
5. Cutting control station.

The laser cutting system is designed to be transportable so that it can be moved from site to site. The robotic arms and rotational indexing table will be located in a cutting area within a contamination containment structure. The trailer containing the laser will be located nearby, but in a clean environment. Each deployment site will provide waste handling and containment control to supplement the laser cutting system. The laser cutting system is expected to be ready for shakedown tests/deployment in June 2000.

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Personal Ice Cooling System (PICS) – Accelerated Site Technology Deployment

Objective and Scope: The objective of the Personal Ice Cooling System (PICS) is to control the heat stress of workers. This project is designed to deploy the PICS Personal Protective Equipment (PPE) to the Fernald's workforce as well as to other DOE sites. Fernald will also implement administrative and educational programs designed to overcome cultural barriers and replace the existing baseline with the PICS. The Personal Ice Cooling System (PICS) (TMS #1898) is a self-contained core body temperature control system that uses ordinary ice as a coolant and circulates cool water through

tubing that is incorporated into a durable and comfortable, full body garment (pants, shirt, and hood). Water is frozen in bottles that are worn outside/inside of Anti-Cs in a sealed, insulated bag with a circulating pump attached to a support harness system. A rate adjustable, battery powered pump circulates the chilled water through the tubing in the suit. The adjustable pump allows the worker to con-trol his temperature based upon his work-load, unlike "ice vests" where the initial cooling is often extreme and uncomfortable. The ice bottle, pump, and suit make up only 12 pounds, a relatively small load. This effort provides the project team with nearly 100 PICS units as well as several central chillers and all required support equipment. The team will deploy various PICS systems (the three-piece [hood, shirt, and pants] suits and/or vests) to each of ten additional DOE sites by a team of Fernald labor-union personnel. This team will conduct proactive workshops on the PICS and their benefits to the workforces at ten other DOE sites (Nevada Test Site, Hanford, Oak Ridge, Paducah, Savannah River, Rocky Flats, Pantex, Los Alamos, Sandia, and Mound). It is envisioned that the educational workshops coupled with leaving "seed" PICS systems will create a demand for the PICS at the other DOE sites. This approach to widespread deployment, using experienced workforce personnel, is similar to the successful approach Fernald used to achieve widespread deployment of the oxy-gasoline torch. Not only will Fernald see the cost savings realized by using the PICS, but other DOE sites will as well.

Status and Accomplishments: During FY 1999, 80 PICS units were deployed at 11 DOE Sites (Nevada Test Site, Hanford, Oak Ridge, Paducah, Savannah River Site, Fernald, Sandia, Los Alamos, Pantex, Rocky Flats, Mound). The deployments were timed to correspond with the beginning of the summer/heat stress season. In initiation of the deployments, training on the PICS was pro-vided to over 200 people. Also, 25 PICS units and two central chilling units have been deployed (Laundry, Sample Line) at Fernald and an additional order within another division for 10 PICS ($15K). Feedback from all of the sites with regard to the deployments has been extremely positive. As a result, the PICS vendor received additional PICS orders in June from three sites (Savannah River, Paducah, Oak Ridge) and one in July from the INEEL; these all total around $65K. Rocky Flats, Pantex, and Sandia are consi dering the purchase of addition PICS cooling suits. Directly and indirectly related to this project, over 150 PICS cooling suits have been deployed across the DOE complex.

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Integrated Decontamination and Decommissioning— Accelerated Site Technology Deployment

Objective and Scope: The overall objective of the Integrated Decontamination and Decommissioning (ID&D) Accelerated site Technology Deployment (ASTD) project is to increase the use of innovative/improved but proven technologies on a large scale in the D&D of facilities in the DOE weapons complex. The reason for increasing the use of these innovative/improved technologies is that each has demonstrated improvements over current baseline methods in cost, schedule, waste generation, radiation exposure, or safety. Increased use on a large scale will be accomplished by doing actual D&D projects with the selected innovative/improved technologies, thereby increasing user familiarity and experience with them and adding them to the array of tools available for D&D projects. The technologies added to the D&D toolbox have all been proven on a smaller scale, either through demonstration in the Deactivation and Decommissioning Focus Area's Large-Scale Demonstration and Deployment Projects (LSDDP's) or through commercial use, but they have not been used to decontaminate and decommission facilities across the DOE complex. After completing the ID&D ASTD project, the DOE expects to see increased use of these technologies that will result in ongoing cost savings at the

Idaho National Engineering and Environmental Laboratory (INEEL), Fernald Environmental Management Project (FEMP), and Argonne National Laboratory-East (ANL-E) and other sites in the DOE complex. The ID&D ASTD project will provide for implementation and deployment of a suite of 12 D&D technologies. These technologies will be deployed on/within over 20 deployment sites (facilities) at INEEL, FEMP, and ANL-E. The anticipated technologies included the: oxy-gasoline torch; track-mounted shear; hand-held shear; GammaCam; BROKK 250 demolition robot; Decontamination, Decommissioning, and Remediation Optimal Planning System (DDROPS); soft-sided containers; snap-together scaffolding; concrete crusher; Personal Ice Cooling System (PICS); lead paint analyzer; and alloy analyzer.

Status and Accomplishments: During the project, the FEMP project team performed D&D on nine facilities 3F, 3G, 8F, 22A, 24B, 38A, 38B, 39C, and 45B and dismantled and demolished them utilizing the oxy-gasoline torch (TMS # 1847), hand-held shear (TMS # 2304), and track-mounted shear-crusher (TMS # 2303) technologies. At the INEEL, the following seven technologies were deployed in some 11 facilities during FY 1999: oxy-gasoline torch (TMS # 1847), GammaCam (TMS # 1840), BROKK 250 demolition robot (TMS # 2100), DDROPS (TMS # 2322), soft-sided containers for waste disposal (TMS # 2240), EXCEL snap-together scaffolding (TMS # 2320), and the Personal Ice Cooling System (TMS # 1898). During the project, the Argonne-East team deployed a BROKK 250 demolition robot (TMS # 2100) for the demolition of the CP-5 reactor bioshield; they also used the oxy-gasoline torch (TMS # 1847) for cutting reinforcing bars in the concrete and other metals in the reactor service area.

Future Activities: In FY 2000, the INEEL project team will deploy three additional technologies. These are the concrete crusher (TMS # 2961), lead paint analyzer (TMS # 2317), and alloy analyzer (TMS # 2397).

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Release of Concrete for Recycle from Decontamination and Decommissioning Projects—Accelerated Site Technology Deployment

Objective and Scope: While most of the concrete waste generated during decontamination and decommissioning (D&D) activities is not contaminated, some portions are contaminated with radioactive or chemical constituents. Because of the difficulties and uncertainties associated with the unrestricted release of concrete, much of the uncontaminated concrete is treated as though it were contaminated and is disposed as low-level radioactive waste.Even concrete, which is shown to be uncontaminated, is disposed either in a sanitary landfill, or is used to backfill the location of the building constructed from the concrete prior to its removal. Disposal at a radioactive or sanitary waste site can be costly and eliminates the opportunity to economically recycle or reuse the concrete.

This Idaho National Engineering and Environmental Laboratory (INEEL) Accelerated Site Technology Deployment (ASTD) project will implement technologies and procedures that will reliably release concrete for unrestricted use following a D&D project. Although, for the most part, solid concrete material can be surveyed and released following application of a decontamination process, concrete rubble because of the size and geometry of its particles has been very difficult to survey accurately enough to gain unrestricted release. The concrete rubble has many options for recycled use. A better understanding of concrete properties relative to decontamination requirements is needed as well as the procedures and protocols necessary to use existing state-of-the-art radiation detection instrumentation and techniques to release this

material for unrestricted use. These procedures and protocols, along with the radiation detection instrumentation, will then be deployed at active decommissioning projects to permit the recycle or reuse of concrete from these projects. The protocols can then be applied on a complex-wide basis to reduce the cost of D&D operations involving concrete removal by allowing for recycle of concrete that meets EPA regulations and DOE orders.

Status and Accomplishments: Although many relatively small facilities have previously been decommissioned at the INEEL, many large facilities await decommissioning. Facilities such as the Engineering Test Reactor, Materials Test Reactor, Power Burst Facility, and a variety of waste handling and laboratory facilities will be decommissioned over the next several years. Each of these facilities contains massive amounts of concrete, which represents tremendous savings potential if it can be recycled. The amount of contaminated concrete at the INEEL is estimated to be as low as 278,000 ft^3 and as high as 354,000 ft^3, while the non-contaminated concrete (including that in the landfill) is estimate at 7.7 million ft^3.

The Security Training Facility has been chosen for this demonstration project. Four thousand two hundred yd3 of concrete will be crushed and disposed of at this facility. Disposing of this concrete using baseline technology, landfill disposal is estimated at $302,554. The new technology is estimated at $73,897, resulting in a projected saving of $228,657. During FY 1999, a deployment plan was prepared including determination of the protocols and procedures associated with this work. Application of the new procedures, and actual release and crushing of concrete using innovative technologies will be accomplished at INEEL during FY 2000.

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TMS #2373

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Deployment of Innovative Characterization Technologies and Implementation of the MARSSIM Process at Radiologically Contaminated Sites—Accelerated Site Technology Deployment

Objective and Scope: One of the most significant issues facing planners of decontamination and decommissioning (D&D) projects is the cost associated with characterization of the facility. There is uncertainty concerning the amount of data that needs to be collected and the level of analysis required in all phases of a D&D project, from the initial planning phase through the closure phase. These uncertainties make it difficult to define the full scope of a project at the outset and to prepare, with confidence, a feasible D&D schedule. This Accelerated Site Technology Deployment (ASTD) project plans to address some of the most important issues associated with facility characterization through the implementati on of the guidelines contained in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM). Additionally, this ASTD project will augment the MARSSIM process through deployment of innovative characterization technologies. This effort focuses on the characterization of the Brookhaven Graphite Research Reactor (BGRR), which is currently undergoing stabilization in preparation for near-term D&D.

Status and Accomplishments: The BGRR was a graphite-moderated and reflected, air-cooled, thermal neutron research reactor that operated from 1950 to 1968. The reactor design included a 25-foot 700-ton graphite cube that was built in two halves separated by a narrow, vertical gap. Filtered cooling air was drawn into this gap and circulated through channels to remove heat from the fuel elements and the graphite cube. The hot air exited the pile into plenums within the graphite cube and then flowed out of the reactor through underground concrete ducts, passing through filters, coolers, and primary exhaust fans before being discharged into a 100-meter high stack.

In 1997, following safe shutdown of the BGRR facility during the 1970's and 1980's,

a site-wide review found radioactive water in the underground air-cooling ducts. Subsequently, it was determined that a comprehensive investigation of the environmental vulnerabilities and overall facility condition should be conducted. The first phase of this stabilization effort involves characterization of the BGRR facility including the following structures and associated systems:

Building 701, Reactor Building

Building 702, Reactor Pile

Building 704, Fan House

Building 708, Instrument House

Building 709, Canal House and Outdoor Pad

Characterization will focus on ascertaining the extent and magnitude of the radiological and hazardous material conditions of these facilities. The radiological characterization will encompass beta/gamma and alpha activity as needed, and will employ surface activity measurements (both fixed point and smears) and surface scans. Cobalt-60 is one of the primary nuclides of interest. Other anticipated radionuclides are tritium, carbon-14, strontium-90, cesium-137, radium-226, uranium-235, and various transuranics. Knowledge of the existence and extent of the radiological and hazardous material conditions will enable timely stabilization of the facility, provide for necessary modifications and/or repairs, and establish the basis of any future decommissioning planning.

Current Reporting Period Activities: The BGRR characterization plan is built around implementation of the guidance contained in the MARSSIM, which provides a nationally consistent, rigorous approach for conducting radiation surveys and investigations of potentially contaminated sites. The focus of MARSSIM is on final status surveys used in determining if a remediated site/facility meets the applicable release criteria. The application of the MARSSIM process at the BGRR facility for initial investigation prior to remediation of decommissioning activities represents one of the first applications of this kind within the DOE complex.

Beginning in June 1999, the Brookhaven National Laboratory began implementation of the MARSSIM process. In situ characterization was conducted using the Canberra In Situ Object Counting System (ISOCS), TMS #2098. The ISOCS uses in situ gamma spectroscopy for the quantification of gamma-emitting contaminants in or on objects of various sizes and shapes. ISOCS has been shown to be cost-effective in almost all applications where field sampling and laboratory analyses are the baseline methods. Results can be obtained immediately following field acquisition, thereby reducing the time delays incurred by physical sampling and laboratory counting. Measurements can be made on sealed systems or remotely, thereby reducing personnel exposures or work hazards. Surveys completed using the ISOCS included surface soil above the Fan House pipeline, south and north ducts at the Above Grade Ducts, open manway in Fan House 5, dust collected from the fan unit in Fan House 3, sludge collected from the Canal House walkway, and a B-25 waste box.

For more information:

TMS #2374

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▼Rocky Flats Environmental Technology Site—Accelerated Site Technology Deployment and the D&D Initiative

To address technology needs and opportunities at the Rocky Flats Environmental Technology Site (RFETS) and positively impact the site's ability to meet its 2006 site closure plans, the DOE Office of Science and Technology (EM-50) Deactivation and Decommissioning Focus Area (DDFA) has partnered with Rocky Flats on several projects. These projects include:

1. *The Fiscal Year (FY) 1998 Accelerated Site Technology Deployment (ASTD) Project*
2. *The FY 1999 ASTD Project*
3. *The Rocky Flats D&D Initiative*

These projects confirm that application of new, proven technologies can accelerate D&D activities and significantly reduce site closure costs.

Status and Accomplishments:

FY 1998 ASTD—Enhanced Deactivation and Decommissioning (D&D) of Gloveboxes

1. *Crimper Cutters Tools*—The large Crimper/Cutter tool (designed to crimp/seal pipes and then cut them) was returned to the vendor under a performance warranty. It did not perform satisfactorily. A small, 2"-pipe cutter is expected to be deployed in Building 771 during the first half of FY 2000.

2. *DISPIMTM*—The Decommissioning In Situ Plutonium Inventory Monitor was first deployed on site in September 1998. The deployment was considered successful, and it is now being implemented on site. Documentation of the deployment is complete and a video has been prepared.

3. *WIPP Certified Standard Waste Box (SWB) Crate Counter*—The mobile SWB counter is a self-contained, trailer-mounted system that can be easily transported around the Site and between DOE sites. The system is based on passive neutron coincidence detection assay technology, which is similar to the technology that has been successfully used for WIPP-certified drum counters. The unit is expected to be WIPP-certified and operational at Rocky Flats in March of 2000.

FY 1999 ASTD—Remote Operation Size Reduction Station (ROSRS) Building 776/777 at Rocky Flats is a former plutonium machining building, which is currently undergoing D&D activities. This two-story structure contains large quantities of piping, gloveboxes and tanks. Wastes types generated will likely include sanitary, hazardous and various low-level, TRU, and mixed, radioactive wastes.

ROSRS will allow size-reduction to be performed by a remotely operated system rather than manually by workers in supplied breathing air with many layers of personal protective equipment and using hand-held cutting tools.

Rocky Flats D&D Initiative—Two projects were completed in FY 1999 under the D&D Initiative, they were:

1. Mechanical cutting tools were purchased and installed in an Inner Tent Chamber (ITC) size-reduction station. The ITC's function is to remove the worker from the atmosphere where size reduction is taking place to improve worker safety and reduce worker exposure risk.
2. A User Requirements Document and Feasibility Analysis for a Centralized Site D&D System were generated and reviewed.

FY 2000 Initiative dollars have initially been allocated to help solve technology need RF-DD21 (Improved Mechanical or Robotic Removal of Lead Shielding from Gloveboxes) on the Rocky Flats Needs and Opportunities List.

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Deactivation and Decommissioning (D&D) Consortium

Objective and Scope: In December 1997, DOE signed a Memorandum of Understanding (MOU) with the Electric Power Research Institute (EPRI) and several nuclear utilities to jointly develop and deploy new D&D technologies. DOE's objective is to expand the reach of benefits of the "leading-edge" technologies being deployed within the DOE nuclear complex. The MOU Consortium established a charter in early 1998 and identified challenging technological areas common to both DOE and the commercial industry. Both DOE and commercial sites will be used for these demonstrations and deployments.

DOE and EPRI are collaborating to conduct quarterly workshops at various nuclear plants around the country, each

focusing on a particular decommissioning area. DOE and the utilities present the most recent, innovative technologies to improve productivity and worker safety while reducing cost. The workshops will solicit feedback from "hands-on" plant managers and field workers. Topics covered to date address: concrete decontamination, imbedded pipe decontamination, and site characterization.

Status and Accomplishments: The efforts supporting the DOE/EPRI/Utility Consortium during the past quarter concentrated on the development of a technology demonstration process to be conducted at utility plants. The first demonstration will be performed at the Big Rock Point plant where the pipe cleaning technology developed by Florida International University will be demonstrated. During the period:

- Southern California Edison signed the MOU
- EPRI/NETL conducted a workshop on hazardous waste at the Big Rock Point plant
- Work began with the Sacramento Municipal Utility District to set up a series of technology demonstrations at the Rancho Seco plant.

At Rancho Seco work began to identify areas where new or better technology would enhance the decommissioning process. Once the areas of interest were identified specific technologies were discussed. These efforts led to the following list of technologies of interest:

- *Survey and Characterization Technologies*
  - Shonka
  - Gamma Cam
  - MACS
  - 3D-ICAS
- *Stainless Steel Cutting Technologies*
  - Laser
  - Water Jet
  - Machining/Milling
- *Large Component Cutting Technologies*
  - Diamond Wire Saw
  - Machining/Milling
- *Concrete Cleaning Technologies*
  - Marcrist Shaver
  - Scabblers
  - Grinders
  - Media Blasting—Grit, Sponge, CO_2 Pellets, Ice Pellets
  - Laser Ablation
- *Chemical Cleaning*
  - Siemans
  - DFD
- *Liquid Processing*

The next step in this process is the development of a series of questionnaires that will be sent to other members of the consortium. The purpose of these questionnaires is to help identify technology needs at other facilities. Once the combined list is completed a prioritization process will be conducted to establish demonstration priorities.

It has also been determined that a demonstration of the Marcrist concrete shaving technology will be planned and executed early next year. This demonstration will be conducted at the Rancho Seco plant. Several areas of contaminated concrete floors at the plant will be used for the demonstration.

An EPRI/NETL workshop on low level radioactive waste processing and minimization is being planned. NETL will provide information on DOE activities that can be incorporated into the EPRI workshop. This workshop will be held in March of 2000; however, the exact date has not yet been scheduled. The information will concentrate technology that has been demonstrated and documented in NETL and DOE programs. NETL will assist in the identification of these technologies and vendors. Where possible NETL will identify presenters and/or the location of information related to the technologies. NETL will also provide basic information on the NETL program and on where the utilities can obtain applicable data on past, current, and future NETL projects. NETL staff and/or NETL contractors will present this information at the workshop.

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Florida International University

Objective and Scope: The Hemispheric Center for Environmental Technology (HCET) at Florida International University (FIU) in Miami, Florida, is working on several D&D-related research projects under a grant awarded by the DOE Office of Science and Technology. These include assessment of metal and masonry decontamination technologies and equipment dismantlement technologies; technology assessment for improved structural demolition and dust suppression techniques; large-bore pipe decontamination; improved roof stabilization technologies; microwave combustion and sintering without isostatic pressure; melting, remelting, solidification, and separation of metals and glass; and assessment of strippable coatings for decontamination and decommissioning.

Status and Accomplishments and Current Reporting Period Activities:

Deactivation and Decommissioning Technology Assessment Program: This project was developed to provide detailed, comparable data for environmental technologies and to disseminate this data to D&D professionals in a manner that will facilitate the review and selection of technologies to perform decontamination and decommissioning.

Universal Ice Blast, Inc. in the first part of May 1999 performed demonstration of an Ice Blasting technology with a chemical softener. A chemical softener is sprayed onto the painted surface and is left for several hours. After the chemical has dissolved the paint, the softener and the reacted paint are removed by scraping with hand tools. The remaining paint was removed by ice blasting. Before blasting by ice crystals, all surfaces to be removed were sprayed with Stingray 874B Paint Stripper and benzyl alcohol and cured overnight. During the blasting process, the majority of the ice crystals sublimed and released to the ambient air. The technology was able to remove coatings from the brick wall at a production rate of approximately 30 ft^2/hr. The technology managed to remove the majority of the paint from the concrete wall at a production rate of 36 ft^2/hr, but was unable to remove any paint from the steel plates and I-beams. The technology required simple equipment setup and little maintenance. No toxic chemicals were used, and little waste was generated.

The En-Vac Robot Blasting System was demonstrated by MHI Marine Engineering, Ltd., at the FIU-HCET, in June 1999. The objective of the demonstration was for the technology to remove coatings from various masonry and carbon steel surfaces. In addition, the technology was to remove approximately ¼-inch of concrete from a floor as well as from a wall. The En-Vac system is an abrasive blasting technology and consists of the En-Vac robot, a recycling unit, a filter, and a vacuum unit. The system uses abrasive steel grit or steel shot as the surface removal media and can work on vertical, horizontal or inverted surfaces.

The En-Vac system performed well on both horizontal and vertical surfaces. Production rates for coating removal from masonry surfaces ranged from 93 ft^2/hr (concrete wall) to 98 ft^2/hr (brick wall). For aggressive removal of concrete, the production rates were 54 ft^2/hr (approximately 0.26 in. of a wall surface) and 89 ft^2/hr (approximately 0.14 in. of a floor surface). Surface removal from metal plates was performed at 95 ft^2/hr for paint removal and 71 ft^2/hr for rust removal. The overall work environment was clean, and no dust emission was observed during the evaluation. Additionally, the grit was recycled many times before it was collected as waste, which greatly reduced the volume of secondary waste.

The Princeton Plasma Physics Laboratory (PPPL) demonstrated the diamond wire cutting technology on the surrogate of the Tokamak Fusion Test Reactor (TFTR), during the end of August and the first of September 1999. The plated diamond wire was successful in cutting through all components of the TFTR surrogate including stainless steel, inconel, and graphite. The demonstration tested three different void fill materials (mortar with sand, Rheocell-15, and foam) and three cooling systems, (water, air, and liquid nitrogen). The optimum combination was determined to be the use of low-density concrete void fill, Rheocell-15 with an average density of 52 lbs/ft^3, using a water coolant. However, the liquid nitrogen performed better than expected with only minor problems and was considered to be a successful demonstration

of the Bluegrass Concrete Cutting, Inc., proprietary liquid nitrogen coolant system. An ITSR is being written that will compare the diamond wire saw to the plasma arc (baseline) technology.

Integrated Vertical and Overhead Decontamination System: This project, which commenced at the beginning of FY 1998, will be used to define and develop a cost-effective system with which to characterize and decontaminate concrete/brick walls and concrete ceilings. To ensure the broad applicability of the system to the DOE complex, a detailed analysis will be conducted to define the concrete/brick walls and concrete ceilings remediation problem set. Field and laboratory testing of this full-scale integrated system will be conducted to aid in the direct comparison of this system with commercially available technologies.

Title I Design for the development of the decontamination and deployment mechanism was completed by RedZone and approved by FIU. Title II Design for the development of the decontamination and deployment mechanism was completed by RedZone and is under review by FIU.

Ex-Situ Large-Bore Pipe Decontamination and Characterization System: The disposition of large-bore pipes is a difficult problem in the areas of decontamination and characterization. This pipe is potentially contaminated internally as well as externally. This situation requires a system capable of decontaminating and characterizing both the internal and external surfaces of the pipe.

The scope of work has been completed for testing and deployment of the system at Big Rock Point. Construction of the four trailers to transport the decontamination system was completed in the end of July 1999.

The decontamination, ventilation, and off-loading systems were inspected at Delong Equipment during the first of September 1999. The integration of the system was completed by the end of September 1999, and the system was shipped to Miami. FIU-HCET personnel were trained on the operations and maintenance of the system during the first of October.

In-Situ Pipe Decontamination System (IPDS): The deactivation of radiologically contaminated facilities in many cases requires the characterization and decontamination of piping systems. The DOE inventory has several thousand miles of piping and ductwork from facilities throughout the United States. The piping and ductwork is contaminated and in-situ pipe decontamination options are limited. Most commercial systems use high-pressure water to clean pipe internals, which generates large volumes of wastewater. The wastewater requires treatment, and in many cases is not aggressive enough to remove heavy scale and contaminants. The goal of this task is to develop a low-cost and efficient system for in-situ decontamination of pipes, which does not release contaminants into the environment or generate secondary waste.

A review of the pipe cleaning system was performed. Discussions held with the various vendors showed that grit blasting technology is a simple and easy-to-use technology that generates less secondary waste than other technologies considered and produces a near-white metal finish. In combination with the grit blasting technology, two drive systems were considered and cost estimates for these systems were developed.

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2.2 Facility Characterization

Portable X-Ray K-Edge Heavy Metal Detector

Objective and Scope: Ames Laboratory and Iowa State University's Center of Nondestructive Evaluation are developing an improved nondestructive assay (NDA) technique for detecting and quantifying uranium, plutonium, and other heavy metals. The work is focused on situations where these materials are located inside sealed containers or processing equipment. The approach this technology uses is based on observing the K-edge absorption transition in X-ray transmission measurements. This technique is being developed to maximize the sensitivity for detecting heavy metals, while minimizing the measurement time.

A project study showed that the K-edge heavy-metal detection technique would be beneficial for many D&D projects, especially those involving gaseous diffusion plants. Its use could have the biggest impact in inspecting the vast amount of piping in the plants. This inspection could be done in situ to allow monitoring of chemical flushing. The high sensitivity of the technique can be used to minimize the danger of contamination to workers and equipment during disassembly operations, resulting in savings of time and money in addition to reducing generation of waste.

Status and Accomplishments: During the first year of the project, FY 1994, the sensitivity of the technique was determined through modeling and laboratory demonstrations, ending with a design of a portable system. In FY 1995 and FY 1996, a prototype portable K-edge heavy-metal detector was assembled and tested in the laboratory. This system consisted of a high-flux X-ray generator, a collimator for minimizing the local radiation hazard and providing the requisite beam characteristics, a monochromator, a real-time imaging detector for simplified alignment, and an energy-dispersive detector for collection of the K-edge data. The equipment, including the X-ray generator and detectors, is controlled by a personal computer. The same PC analyzes the raw data, with the result being made available to field personnel. Sensitivity comparable to the original laboratory tests was achieved, and measurement time was reduced by a factor of two. A 2-mm layer of uranium was successfully measured through 1 in. of steel. The K-edge system analyzed thorium contamination in seven drain lines in Wilhelm Hall. Minimal contamination was found in two lines, significant thorium contamination in three lines, one line with mercury contamination, and one case of a drain trap contaminated with uranium, thorium, and mercury. This was the first true in situ demonstration of the K-edge system. The K-edge system was demonstrated at the Savannah River Site to measure the amount of highly enriched uranium (HEU) in the rooftop ventilation ducts for the Machining Room lathes. Sixty-six wide-angle images and 66 narrow beam spectroscopic shots were made during the demonstration. Approximately 84 feet of ventilation duct were assayed. When gram quantities were found, the precision was in the ±3% range. About one quarter of the narrow beam measurements identified a significant amount of HEU.

Current Reporting Period Activities. Improvements were made in interpolation algorithms used to determine total heavy metal contamination based on X-ray images combined with selected K-edge measurements. This method was applied to the data from the SRS 321-M LSDDP. Contact was made with a representative of D&D operations at Oak Ridge, and he was supplied with a summary of the K-edge technology. Further discussions regarding specific needs at Oak Ridge are anticipated.

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TMS #134

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The K-edge technology is effective even through 1-inch-thick steel.

▼Airborne and Ground-Based Laser-Induced Fluorescence Imaging:

LIFI scans large areas quickly and enbles video playback.

Objective and Scope: Laser-induced fluorescence imaging (LIFI) is an optical technique that exploits the detection of fluorescent compounds irradiated with laser light or filtered conventional light sources. Fluorescence is the prompt luminescence of a material caused by an external stimulus in this case, a laser. LIFI applications include the detection of uranium during D&D activities.

LIFI addresses the need for rapid survey tools to monitor sites remotely, identify contaminant "hot spots," assist in cleanup activities, and monitor remedial progress. In the future, LIFI may be used to verify site cleanup if regulatory sensitivity can be achieved and verified through field tests. Development and field testing of an airborne survey tool for fluorescence and reflectance signature detection promises area coverage of sites that are either spread out geographically (e.g., uranium firing sites) or sites that have poor access, such as clay cap areas.

The high spatial resolution of the LIFI process provides a digital picture of the extent of surface uranium contamination. This capability allows mitigation efforts to be focused on specific areas, speeding the survey time and lowering overall costs. The ability to record imaging data on videotape allows for playback and review in order to plan and evaluate D&D activities.

The scope of this task includes a variety of techniques to exploit LIFI in several applications, including aerial remote sensing and uranium detection on surfaces using handheld portable survey tools.

Status and Accomplishments: Since the project's inception in FY 1993, the handheld and airborne LIFI systems have been designed, fabricated, and tested. Necessary hardware, software, and analysis methods have also been developed. The handheld system has been deployed at the East Tennessee Technology Park (the former Oak Ridge K-25 Site) to detect uranium at the uranium cylinder storage yards. The handheld unit was demonstrated at the Fernald Plant 1 Complex, where LIFI readings were correlated with standard radiological survey instruments. A backpack system has been completed and performed well in indoor and outdoor tests. Tests included collecting LIFI images from uranium glasses performed both outdoors in sunlight and indoors in room light conditions. A companion system is being shipped to Ft. Belvoir, VA, for further evaluation.

Current Reporting Period Activities: The Laser-Induced Fluorescence Imaging (LIFI) system was improved with real-time, range-finding capabilities and software/hardware updates in preparation for the September 20th to 22nd deployment at the K-33 building at the Oak Ridge Operations site. Standard operating procedures were also updated. The deployment was arranged by FIU-HCET, in cooperation with the site subcontractor, BNFL. In preparation for the work, the subcontractor made measurements that showed the major contaminant at the K-33 and K-29 buildings was ^{99}Tc instead of the expected U (as stated in the Project Baseline Summary and STCG needs). The subcontractor made a business decision to treat the ^{99}Tc decontamination first and cancelled the LIFI deployment. The objective was "hot spot" identification for surface uranium contamination on structural steel, concrete floors, and transite walls. The contamination ranged from "background" to "high." Visual maps of U contamination were expected to speed up the decontamination of large areas. BNFL wanted to use the LIFI technology as a decon assist tool. Standard methods were to be used for regulatory compliance.

Work was performed to understand the sources of "false positive" signatures observed during our LIFI demonstration at K-27, Oak Ridge, this past March. Samples of galvanized metal were investigated and found to be free of phosphorescence. Special Technologies Laboratory would still like to obtain galvanized metal from the site that would be representative of metal from that period of construction (1940-1950).

A description of the enabling technology work performed is being developed in conjunction with FIU-HCET to identify users interested in cesium and other radionuclide D&D work. This work would chemically alter radionuclides to form fluorescent species detectable using the LIFI technology.

The LIFI is in the screening phase of the LSDDP for Idaho National Engineering and Environmental Laboratory.

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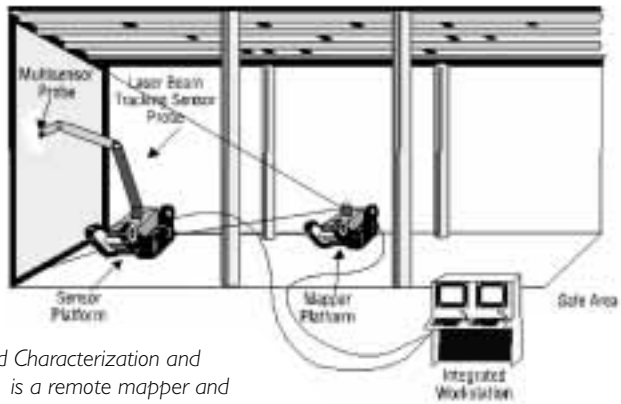
Three-Dimensional Integrated Characterization and Archiving System (3D-ICAS)

Objective and Scope: Coleman Research Corporation (Coleman) will develop a remote system that can rapidly analyze in situ hazardous organic and radionuclide contaminants on structural materials. This remote system is the Three-Dimensional Integrated Characterization and Archiving System (3D-ICAS). The 3D-ICAS consists of a mobile sensor platform and a mobile mapper platform that operate in contaminated areas, and an integrated workstation that remains in a safe location. Development of this technology will occur in three phases.

Status and Accomplishments: The 3D-ICAS was successfully integrated with mobile platforms at Oak Ridge National Laboratory. The Coherent Laser Radar Mapper was operated on the OmniMate robotic platform and the contaminant analysis units and robot arm carrying the multisensor probe head were integrated on the overhead transporter. The system was subsequently demonstrated at Oak Ridge National Laboratory, Robotics & Process Systems Division in October 1998. The demonstration was conducted in the hi-bay area using a wall unit specially constructed for the demonstration. The wall unit consisted of pieces of cement-based wallboard and a small piece of an asbestos containing material. The wall unit was purposely contaminated with low-levels of organic materials, alpha emitters, and a beta emitter. The demonstration consisted of mapping the wall unit, displaying the map, selecting points to be surveyed, running the contaminant survey which required moving the sensor/analysis unit with the transporter and acquiring the sensor unit with the 3D mapper, displaying the measured contamination in real time, and displaying detailed spatial and contamination data after the survey was completed. An unfortunate hardware failure the morning of the day before the demonstration prohibited acquisition of contaminant data from the high-speed gas chromatography/mass spectrometry (HSGC/MS) and only the Molecular Vibrational Spectrometer (MVS) provided real-time identification of the substrate material during the demonstration. This was a significant success since the MVS correctly identified the wallboard as being cement even though the particular substrate sample had not been included in the system's neural network training set. Failure of the HSGC/MS was unfortunate, but its performance had been well documented and demonstrated prior to the demonstration at ORNL and it did not detract from the main objective of the demonstration, which was to show end-to-end system operation with the 3D-ICAS mounted on ORNL mobile platforms. The GC/MS was shipped back to Thermedics and they are in the process of replacing the parts and recalibrating the system. When complete the system will be shipped to the DOE-EM Laboratory in New York City for the validation testing.



Three-Dimensional Integrated Characterization and Archiving System (3-D ICAS) is a remote mapper and sensor platform to use in contaminated areas

Current Reporting Period Activities: A project review meeting was held at Thermo Electron Research and Development Center at Woburn, Massachusetts, on September 29, 1999. The enhancement of the system is about 80 percent complete. The technical issues which include user interface concept, database concept, and sensor suite are being further explored for a good working system. The work is focused on the set of guidelines/ defaults for operation. The system should be capable of logging measurements, so that the operator does not need to organize measurements or keep a notebook. Coleman Research Corporation is looking at a local site to test the system before taking to the demonstration site. The laboratory testing is expected to be completed by the end of November 1999. The final demonstration is expected to be performed early next calendar year.

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Fast Response Isotopic Alpha Continuous Emissions Monitor

Objective and Scope: The objective of this effort is to develop and test Continuous Air and Emission Monitoring (CAEM) instrumentation for alpha-emitting radionuclides. This instrument will be designed in order to certify the proper performance of airborne emissions from ambient air and in equipment emissions encountered during D&D of DOE's surplus facilities. The proposed system will also meet the DOE's alpha CEM requirements through the development of an innovative, high-resolution, on-line air/ gas alpha monitor. The instruments will be capable of operating either as a stack emissions monitor, a process control instrument, or for the control of off-gas from decontamination, dismantlement, and air handling equipment.

Initial efforts will be focused on the development and evaluation of a rapid alpha-counting-based instrument to monitor ambient air and emissions to meet the monitoring and equipment control needs of surplus facilities undergoing decontamination and decommissioning. This development will establish the feasibility of a prototype instrument for use in detecting radionuclides that are present, or create susceptibility to exposure, throughout the DOE complex. The prototype instrument will be tested under the supervision of DOE's Inhalation Toxicology Research Institute in Albuquerque, New Mexico. Based on the prototype results efforts may be continued to full-scale commercial prototype for demonstration in one of the Deactivation and Decommissioning Focus Area's Large-Scale Demonstration and Deployment Projects.

Current Reporting Period Activities: Initial laboratory testing of the system showed that the Fast Response Isotopic Alpha Continuous Air Monitor does respond well to the liquid phase alpha particle spectroscopy. A redesign of the prototype CAM instrument was begun in order to improve the instrument's performance. This redesign includes an improved detector mount, for enhanced alignment of the detectors to the film, and an enhanced film tracking system, to improve alignment of the film to both the ESP and the detectors. Several changes to the film transport system are

being made to accommodate the enhanced film tracking system.

Informal meetings were held with various DOE CAM end users. For example, the personnel associated with Los Alamos National Laboratory's (LANL's) upgrade of their continuous air monitoring system for the Plutonium Facility at Technical Area 55 (TA-55), continue to be very interested in the further development of the Fast-Response CAM. LANL was interested in hosting the Phase II field test in their back yard, at the LANL TA-54 Large-Scale Demonstration and Deployment Project.

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2.3 Facility Decontamination

High Productivity Vacuum Blasting System

Objective and Scope: The objective of this project is to improve the productivity and economics of existing vacuum blasting technology, which is used to remove radioactive contamination, PCB's, and lead-based paint and provides worker protection by continuously recycling the material and dust from the decontamination tasks. This work will focus on re-designing and improving existing vacuum blasting components, including: blast head nozzles, ergonomic handling of the blast head by reducing its weight, brush-ring design, vacuum level regulator, efficiency of dust separator, and operational control sensors. The redesign is expected to enhance the productivity and economy of the vacuum blasting system by at least 50 percent of current vacuum blasting systems.

LTC Americas will develop the necessary mathematical models of air-particle flow in the nozzle, in the blast head and interface area, and in the dust separator to study the flow characteristics and interaction of the various elements of the system. The purpose of this model development is to increase the productivity and economy of existing vacuum blasting technology by 50 percent. Based on the results of this modeling effort, the contractor shall experimentally test and verify that the above system components perform according to the mathematical simulations and complete the preliminary design of the components of the proposed system. This will include an overall configuration of the system including material selection and testing, definition of the range of dimensional and weight parameters, conceptual arrangement or design of the blast head unit, and dust separator unit. Based on the preliminary design, the contractor will procure components, and perform fabrication and assembly of the proposed system.

The performance of the system will be evaluated in the laboratory mock-ups representing various clean-up situations and environments. The contractor will review, analyze, and interpret data collected from the tests and develop a productivity enhancement profile of the pre-prototype unit including economic analysis. Based on the laboratory test results, the contractor shall modify, change, and make adjustments to enhance the capability of the system.

Status and Accomplishments: Phase I has been completed. In phase I, mathematical models and related code to simulate the entire process numerically were developed. Based on the date from the model an innovative rectangular nozzle and a new centrifugal separator were designed, manufactured, and tested. The tests were performed to verify the mathematical models. The numerical results agreed with the measured data with a deviation within 10 percent. Experimental results also showed that if the new innovative design rectangular nozzle replaces the old circular nozzle, more than a 50 percent increase in productivity efficiency could be achieved. The newly designed centrifugal separator offers a high efficiency separation increase from about 30 to 75 percent, even using finer abrasives.

Current Reporting Period Activities: Phase II has been initiated. In Phase II, a pre-prototype of the nozzle, blast head with wind curtain, sensors and dust separator will be designed, constructed and tested to assess the performance of the new design under controlled conditions at the con-tractor's facility.

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Demonstrations of Light-Aided Technologies for Hanford D&D Projects

Objective and Scope: Pacific Northwest National Laboratory (PNNL) is demonstrating a laser-aided cutting technology with a 2.4-kW neodymium-doped yttrium aluminum garnet (Nd:YAG) laser system for the size-reduction of materials and equipment in high-radiation environments to assess its applicability to dismantlement efforts at Hanford and other DOE sites.

The B-Cell Cleanout Project at the Hanford 324 building has necessitated the removal and size-reduction of several large, multi-ton, chemical-processing racks. The project has used commercial saws and hydraulic shears, a plasma torch, and a water knife to cut up equipment in the hot cell. Each system has drawbacks, including low cutting rates, high waste generation, or applicability to a narrow range of metals and geometries. Nd:YAG laser systems are used for metal cutting in automotive facilities worldwide and in many other manufacturing plants. The focus of this demonstration will be remote use of a fiber-fed laser cutting system: (1) to size-reduce materials in a low-radiation, remote-handled environment (cold test), and (2) to size-reduce equipment with minimal secondary waste generation and assess the capability, performance rate, and effective life span in a high-radiation remote-handled environment (hot test).

At the end of the cold test, a review will be conducted to determine whether the laser system should be tested in the radioactive environment of the B-Cell. Project staff will conduct the review with input from building, laboratory safety, hot cell operations, and DOE-RL staff. The hot test will involve using the laser cutting system in the B-Cell to size-reduce Tank 119. Other materials in the hot cell may also be cut. Five sets of high-range dosimeters will measure the dose to the fiber optic cable to assess any degradation in quality of the laser cutting system during the hot test.

Status and Accomplishments: The Pacific Northwest National Laboratory developed a remote laser cutting size reduction technology to cut metal equipment of almost any size and shape in a remote-handling, high-radiation environment. The technique is an adaptation of the commercial laser cutting method commonly used in automotive manufacturing and other industrial applications. Laser cutting is performed by generating a laser beam in a water-cooled laser power unit, transmitting this beam through a C-2 fiber optic cable, and cutting with the beam using an end effector that incorporates a focusing optics package and an assist gas injection port. While most industrial applications manipulate the laser end effector with a robotic device, the laser cutting end effector is manipulated with a standard hot-cell master/slave manipulator.

The laser cutting system performed very well in the cold testing and met all the project objectives. Laser cutting proved to be somewhat faster and much cleaner than the plasma torch. Laser cutting is a somewhat faster (estimated at 20 percent faster speed) and much cleaner technology, generating less smoke and metal vapor. The second phase of the project, laser cutting in the B-Cell never occurred due to funding constraints and scheduling. However, there was some Awarm@ tests conducted in the B-Cell entryway that were successful, but inconclusive. Hot test cutting was simulated by radiating the fiber optic cables using a known cobalt-60 source. Two competing processes affect the transmission of laser light through a fiber optic cable in a radiation environment—radiation darkening and photobleaching. The results of these tests (to be presented in the Innovative

Technology Summary Report) indicate that darkening occurs with the higher radiation exposures, but that in many of the cases the photobleaching with fiber optic cable use does result in near return to initial transmission values.

Current Reporting Period Objectives: The Innovative Technology Summary Report is being prepared.

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▼Advanced Technologies for Decontamination and Conversion of Scrap Metal

Project Conclusion: Manufacturing Sciences Corporation (MSC) developed and demonstrated a cost-effective electrorefining process for decontamination of nickel-containing radioactive scrap metal and conversion to useful new products.

The electrorefining process consists of a refining cell that is divided into two compartments separated by a permeable membrane. In the anodic compartment, feedstock nickel anodes are dissolved electrolytically in a sulfate-based electrolyte. The electrolyte from the anodic compartment (anolyte) is continuously withdrawn via a pump and circulated through a bed of nickel powder, or some other liquid-solid contactor, where the ^{99}Tc is deposited in its metallic state via the displacement reaction with nickel. The ^{99}Tc-free, treated anolyte is then filtered and split into two streams. One stream is returned to the anodic chamber, while the second stream is added to the cathodic chamber. The stream flow volumes are adjusted so that the cat-olyte liquid level is 2 to 6 inches above the anolyte liquid level. This will insure a continuous flow of electrolyte from the cathodic chamber through the permeable membrane to the anodic chamber via the hydrostatic pressure differential. This flow prevents the diffusion of pertechnetate ions from the anolyte through the membrane into the catolyte. Purified nickel is deposited from the ^{99}Tc-free catolyte onto thin foil "seed" nickel cathodes. The cell operates on a semi-continuous basis, needing to be interrupted only when the cathodes and anodes must be replaced. The electrolyte can be used for extended periods of time, and will only have to be treated or replaced to remove accumulated contaminants, which are present in trace amounts in the feedstock nickel.

Electrorefining technology cell

During the project's first phase, experiments were performed to determine optimum conditions for effective removal of radioactive contaminants. Major accomplishments in Phase II were the successful lab-scale and pilot- scale demonstrations of electrorefining technology to remove Tc from diffusion plant nickel. Phase III included a full-scale demonstration (1,500 gal) of electrorefining technology utilizing barrier nickel. Throughout the testing and demonstration phase, the anode contamination ranged from 250 Bq/gm to 627 Bq/gm. At steady-state conditions, cathode decontamination results down to around 1Bq/gm were achieved.

DOE has awarded a contract to BFNL, Inc., to decontaminate three huge buildings at the East Tennessee Technology Park (ETTP) (former K-25 Site) and help prepare the Oak Ridge installation for private use. Cleanup of these three buildings will include the disposition of over 126,000 tons of metals. Manufacturing Sciences Corporation (MSC) is a teaming partner with BNFL to decontaminate nickel and other metals. The electrorefining technology developed under this contract will be deployed to decontaminate 6,000 tons of nickel alone along with other metals.

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TMS #234

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Asbestos Pipe Insulation Removal System (BOA)

Objective and Scope: Most of the steam and process piping in DOE facilities is clad and insulated with asbestos containing material (ACM), which must be removed before any decontamination and dismantling activities can occur. Manual removal is expensive and time consuming because of the carcinogenicity of asbestos fibers, radiological contamination, and abatement regulations of the EPA and the Occupational Safety and Health Administration. Carnegie Mellon University (CMU) is developing and demonstrating a mechanical asbestos removal system that can be remotely operated without a containment area. This technology, known as BOA, is a pipe-crawling, asbestos-removal robot supported by a mobile, boom-vehicle robot that places the pipe-crawling robot and then seals and bags removed asbestos.

Development of the BOA technology will occur in two phases over a two-year period. Phase I will develop a prototype BOA pipe-crawler robot. Phase II will integrate the BOA pipe-crawler robot with the boom-vehicle robot.

Status and Accomplishments: Development of the prototype BOA pipe-crawler robot is complete. Laboratory demonstrations were completed at CMU and a field demonstration was completed at Oak Ridge in the back of K-1210 on the old K-25 site (now ETTP) in Oak Ridge, TN. Air quality was independently monitored and found to be far below (by factors of 6 and 2, respectively) the EPA established limits of 0.1 fibers/cm^3 over an 8-h time-weighted average period and clearance samples below the maximum of 0.01 fibers/cm^3 for a 1500-L air sample. The two-operator scenario was demonstrated and shown to be workable, with all on-pipe and off-board logistics equipment essentially operating autonomously. During the field demonstration it became clear that it would be advantageous to harden certain features of the on-pipe system to allow it to work on the more prevalent 3-inch pipe at K-25 and Y-12.

The Asbestos Pipe Insulation Removal Robot System dubbed BOA placed second in a national design competition hosted by the renowned *Design News* trade journal/magazine. BOA was selected from a large number of national entries, and it was judged one of the most innovative new designs and products in the United States in 1997/1998. Based on the performance of a robot abating at a rate of 30 linear feet per hour, compared with about 3 to 6 feet in DOE/industry, with associated per-foot abatement cost ranging between $25 and $150 for DOE/Industry, it was determined that substantial savings could be realized with the use of such a robot system. Overall abatement costs could decrease between 25 and 50 percent depending on whether the system replaces a current glovebag or full containment method. The BOA system will assist DOE in reducing the cost of asbestos abatement as part of decontamination and dismantlement activities across the weapons complex.

The complete system was tested on long runs and hanger-passes for 3-inch diameter piping. The complete on-pipe abatement head and off-board logistics system was hardened through lengthy and exhaustive abatement runs, all of which were performed on lagged insulation and including many hangers. The abatement productivity and reliability was maintained and the viability of using the system on 3- and 4-inch diameter piping was certified. The system is now ready for field-testing.

Current Reporting Period Activities: The BOA robot was delivered to the Pentagon Wedge 1 Renovation Project in late June. The system was set up and English and Spanish-speaking operators trained in its use over a 2-day period on a mockup test pipe. A full 270 feet of 4-inch pipe hung at 12 feet, with 1.5 inch insulation, was enclosed in a vacuum enclosure to allow the testing, while performing air monitoring at the same time. A crew of three operators was used for the training and the initial testing. On July 7, the Pentagon arranged a media event. Several television networks, including ABC, CBS, CNN, and the Discovery Channel were present. The system performed very well during these tests.

The pilot test was started on July 9, 1999. The robot abated a total of 6 feet, while running into continual

problems with a very thick canvas-layer covering the insulation—the cutters continually wrapped and clogged themselves with the canvas cloth, thereby, never being able to fully cut the insulation without continual manual clearing of the coverhead. The robot had to be shut down and cleaned out. Instead of changing cutting types, the team decided to strip the canvas insulation, i.e., encapsulate the underlying cheesecloth and aircell for renewed abatement attempts the following week.

Testing could not be resumed because the BOA system was totally immobilized. A meeting of all the Team members was held on July 19, 1999, to discuss the status and future action. It was decided to bring the system back to Pittsburgh, repair the system, and operate at Pittsburgh and repair it. CMU will prepare a plan with schedule and cost and submit to the National Energy Technology Laboratory.

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Robotics Crosscutting Program

Objective and Scope: The Robotics Crosscutting Program (RBX) supports the D&D Focus Area (DDFA) through technology development, close interaction with D&D Industry and University Programs funded through the National Energy Technology Laboratory (NETL), and introduction of new robotics technology into the DDFA's Large-Scale Demonstration and Deployment Projects (LSDDP). Overall emphasis of the program continues to be design and integration of remote systems and capabilities used for facility deactivation and ongoing surveillance and maintenance activities with extended application to final facility D&D tasks. Deployment of remote D&D systems will reduce worker exposure to hazardous environments and provide

productivity increases leading to substantial cost savings.

Status and Accomplishments: FY 1999 activities for the RBX in support of the DDFA were focused on providing technical expertise to complete system enhancements and deployment of remote characterization systems in the Hanford 221-U facility ventilation tunnel as part of the Hanford Canyon Disposition Initiative (CDI). RBX personnel also provided technical support for system enhancements to the Remote Underwater Characterization System (RUCS). The RUCS was originally demonstrated at the Idaho National Engineering and Environmental Laboratory (INEEL) in FY 1998 as part of the DDFA's LSDDP for Fuel Storage Canals and Associated Facilities D&D. As a result of this successful demonstration, INEEL personnel subsequently deployed RUCS in FY 1998. RUCS was deployed again in FY 1999 at the Test Reactor Area Building 660 on May 5, 1999.

RBX has also started three new initiatives in support of the DDFA in FY 1999. The first, is the development of a compact remote operator console capable of providing remote viewing and tool control for a variety of commercially available mobility and manipulation systems. This system builds on DOE experience in remote system operation and human-machine interface. The compact console will be integrated with low cost remote dismantlement and demolition systems (e.g., the Dual Arm Work Platform, Schilling manipulators, and the BROKK remote demolition system) for use in areas where radiation, chemical, or industrial hazards prohibit or restrict manual operation.

The second new RBX initiative is the development of telerobotic control of

remote systems. Telerobotic control provides computer control of system operations, reducing the workload of the operator and increasing system effectiveness through more efficient execution of many tasks. The primary candidate for heavy manipulation in D&D is the Schilling Titan class hydraulic manipulator. DOE expertise in hydraulic control and robotic control systems provides an opportunity to enhance the control for the Schilling manipulators to allow telerobotic operation of these systems.

The final RBX initiative started in FY 1999 is the development of telerobotic systems for D&D of below-grade structures and equipment. There are many below-grade equipment enclosures (pits) with overhead access. Examples of such equipment pits are the filter pits at Idaho and the much more numerous riser pits associated with the underground storage tanks at Hanford. The process cells within the canyon facilities are further examples of this type of environment. Most of these facilities have radiation or contamination levels that require remote operation for any characterization or D&D functions. These facilities represent target application sites for the telerobotic manipulation system based on the Schilling manipulator, the RBX compact console, and the telerobotic control capability. This activity is also coordinated with the RBX Tank Waste Retrieval product line to address the riser pit decontamination task for the Hanford underground storage tanks.

Current Reporting Period Activities: Following successful field testing of the Andros robot, lifting platform, and ancillary equipment during the week of August 16, 1999, the Robotics Crosscutting Program Pacific Northwest National Laboratory (PNNL) team successfully deployed the system in the U-Plant ventilation tunnel on Wednesday, September 8, 1999. The robot, equipped with two camera and lighting systems, a gross gamma detector, smear sample pads, and two gamma spectroscopy sensors was lowered by crane into the tunnel via 3-foot by 3-foot access chimney. Two additional camera and lighting systems were deployed into the tunnel on the robot's lifting platform. The robot spent more than five hours in the tunnel, and traveled the length of the 750-foot tunnel, collected detailed video of the structure (walls, floor, and ceiling), and collected two smear samples from the floor. The paint or fixative on the walls and floor of the tunnel was peeling extensively, and the floor of the tunnel was covered in 1- to 2-inches of dust and debris. There were no obstructions in the tunnel and no visible structural problems. The highest radiation level found was 260 mRem/hr. The Andros robot and all associated equipment was safely removed from the ventilation tunnel. The robot was not severely contaminated and thus will be available for future missions.

On Thursday, September 9, 1999, staff from PNNL, Bechtel Hanford Incorporated (BHI), and DOE Richland participated in a press conference with three area television stations (local ABC, CBS, and NBC affiliates) and the Tri-City Herald newspaper reporters. Coverage on all television stations was broadcasted on Thursday evening as well as the following morning. The story made the front page of the Tri-City Herald newspaper.

Key components for the compact console have been received at the INEEL and RBX support personnel are assembling and testing the system for a planned November 1999 deployment of the integrated BROKK and compact console system. The current plan is to deploy the BROKK system to a section of the reactor vessel at TRA-660. A second deployment at the INEEL's Test Area North Facility is also being pursued.

Several additional opportunities to deploy the compact console in FY 2000 have been identified at Oak Ridge. One possibility is to incorporate the compact console with the Dual Arm and Rosie systems for piping dismantlement at the K25 site's K-1420 Building. Technology transfer opportunities of the compact console design will be investigated in FY 2000.

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2.5 Worker Safety and Other Projects

Advanced Worker Protection System

Objective and Scope: Oceaneering Space Systems (OSS) will develop and demonstrate the Advanced Worker Protection System (AWPS), a self-contained, extended-service-time breathing and cooling system. The AWPS uses a liquid air backpack to provide air to workers for both breathing and cooling. Breathing air is provided to a pressure-demand respirator worn by the worker. Air is also used to cool water that is circulated in a liquid cooling garment worn against the worker's skin. The worker can wear either a two-piece splash protection suit (Level B protection) or a totally encapsulating suit (Level A protection).

Status and Accomplishments: A full-scale prototype AWPS, for both Level A (vapor protection) and Level B (liquid-splash protection) has been developed. The Institute of Environmental Research at Kansas State University completed human-performance tests on an AWPS suit. Firefighters from Manhattan, Kansas were the test subjects. The firefighters walked on a treadmill at 3-mph wearing three different types of apparel: shorts and T-shirt, the AWPS, and standard clothing and self-contained breathing apparatus (SCBA) worn by firefighters. Firefighters were able to walk on the treadmill for 90 min when wearing the AWPS, but only 20 to 30 min when wearing the standard firefighting suit.

OSS demonstrated the AWPS liquid-air cooling system at the International Union of Operating Engineers (IUOE) Innovative Technology and Emergency Response Demonstration at the IUOE Joint Apprentice Training Center in Las Vegas, NV. In a dramatic demonstration, a subject dressed in an AWPS and another in a conventional protective garment and breathing apparatus were given some simple physical tasks to perform. The subject in the conventional gear became intolerably hot within about 30 minutes. The subject in the AWPS remained in the gear and breathing apparatus for almost 2 hours and 30 minutes, and emerged without any reported discomfort from the gear or the work.

A heavy equipment operator tests the AWPS.

Current Reporting Period Activities: OSS is focusing on documenting the current design and its history in the final report.

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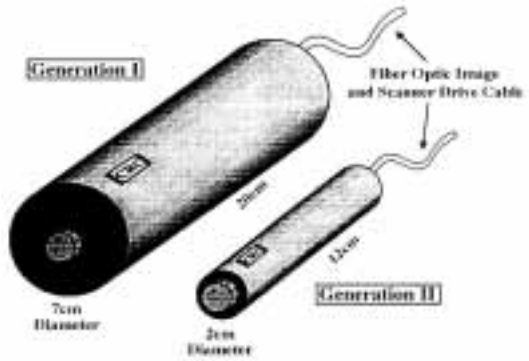
Coherent Laser Vision System

Objective and Scope: The objective is to develop and demonstrate a sensor that can provide timely, accurate, and reliable three-dimensional position and orientation data in a dynamic environment. Without reliable, accurate, and timely position and orientation data robotic operations face severe restriction to avoid collisions in conducting contact operations. The Coherent Laser Vision System (CLVS) is a lightweight, compact, robust sensor that provides scanned images of 256 X 256 pixels at a rate of one frame per second.

The project is planned in two phases. Phase I includes the development of a prototype system

with a two-dimensional scanner, a frame density of 128 X 128 pixels at one frame per second, and a 1.5-m depth of range. In Phase II, the receiver will be upgraded, the frame density increased to 256 X 256 pixels, and the operating range increased to beyond 5 m.

Status and Accomplishments: Coleman Research Corporation (CRC) has completed the development of the prototype CLVS with a no-moving-parts scanner and a baseline frame size of 128 X 128 pixels. The CLVS consists of an optical receiver, scanner, digital receiver, and video monitor. The CLVS is a fiber-optic-coupled FMCW coherent laser radar. The radar uses the relatively large tuning range of injector laser diodes to achieve greater precision than available with other techniques. An eye-safe laser source is used. An acousto-optic (AO) scanner is used to steer the laser beam and enable addressability of all pixels. A smart digital receiver, that retains knowledge of which pixels have recently changed, permits an efficient processing scheme by avoiding broad-range searches and concentrating the effort on the dynamic portions of the scene. The fiber optic architecture of the system offers an extremely robust, compact design. Phase II, the final portion of the development effort, will focus on improving system performance: image quality, image size, and depth of range.



Advancing from the first-generation prototype, Coleman Research is developing a smaller but higher-resolution sensor.

Current Reporting Period Activities: Coleman Research Corp. is preparing the final report documenting results of Phase II.

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Protective Clothing Based on Permselective Membrane and Carbon Adsorption

Objective and Scope: Membrane Technology and Research, Inc. is developing and demonstrating improved protective clothing that provides protection equivalent to current garments, but is lighter weight to improve comfort and is breathable to allow water vapor to escape, therefore reducing heat stress. Improved protective clothing will be made of an innovative fabric that combines an ultrathin, permselective outer membrane with a sorptive inner layer. The outer membrane is extremely permeable to water vapor escaping from the wearer, but highly impermeable to hazardous compounds. The sorptive inner layer captures any hazardous compounds that may breach the outer membrane. Fabric properties will be optimized and prototype suits will be tested during Phase I. In Phase II, a minimum of 300 suits will be fabricated and used in a variety of extensive, comparative trials in the laboratory and at hazardous and nonhazardous DOE field sites.

Status and Accomplishments: Development of fabric materials and laboratory tests on the fabric have been completed. In laboratory tests, water vapor transmission rates of 600B900 g/m^2/day have been measured through the fabric. This water vapor transmission rate is far superior to butyl rubber suits with a water vapor transmission rate of 0B10 g/m^2/day. Chemical vapor transmission rates have been equal to or lower than the fabrics of commercial suits.

Two rolls of the fabric were laminated by Uretek. One roll of fabric (90 m by 30 in.), MTR1, uses rip-stop

An innovative fabric combines an ultrathin, permselective outer membrane with a sorptive inner layer.

nylon as both inner and outer layers, and the second roll (40 m by 30 in.), MTR2, uses the rip-stop nylon on the outside and a flexible, lightweight, nonwoven fabric on the inside. The prototype suits manufactured by Kappler Systems received the following tests by outside laboratories: chemical permeation, physical properties, sweating mannequin, and heat stress modeling. In general, the results are not as good as expected: although the fabrics do combine water permeability (and reduced heat stress) with chemical protection, neither the chemical permeation resistance nor the reduction in heat stress was as high as hoped. The economic analysis was updated based on this new data. The analysis shows that MTR1 provides the greatest benefits in productivity; however, the benefit does not appear to justify the higher cost of the suit made of this fabric. MTR2 fabric has less productivity benefit and a higher selling price, and so is less attractive than MTR1.

Current Reporting Period Activities: The permselective garment testing by the International Union of Operating Engineers (IUOE) was concluded at the end of July. The garments tested, for personnel comfort and well-being of the worker while performing work, were those assembled by MTR's potential commercialization partner from the permselective fabrics supplied by Membrane Technology and Research (MTR), Inc., Tyvek, and non-breathable garments like Saranex. The garments were all full bodysuits with hoods (for comparison purposes), and contained a more spacious cut in the chest and waist/crotch area than other manufactured garments, and this was very noticeable and appreciated by the test personnel. This also helped the garments to be more durable. Examples of tasks performed include crawling through confined spaces, performing metal grinding, and loading and hauling material in a wheelbarrow. The MTR garments, in general, were as comfortable, with respect to heat-stress, as the Tyvek garments, and extremely so, over the non-breathable garments. The test personnel all had very good comments concerning the MTR garments. Further results will be presented as soon as they are available.

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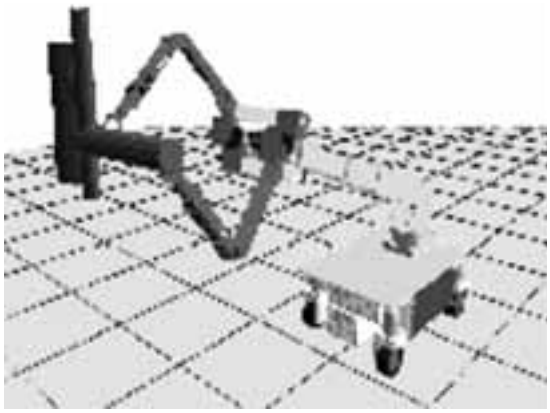

The Robot Task Space Analyzer will characterize the geometry of tasks for robots.

▼Robot Task Space Analyzer (RTSA)

Objective and Scope: The objective of this project is to develop, integrate, and test a sensor and software system called the Robot Task Space Analyzer (RTSA), a tool that gives robot work system operators the ability to characterize the geometry of tasks to be performed. This geometrical data is necessary to allow selected robot tasks to be automated. The work will be accomplished by developing a combination of software, sensors and computing hardware that enhance the performance of robotic equipment used in typical environmental remediation and waste management projects.

RTSA is an enabling technology necessary for the deployment of telerobotic automation in D&D. It is conservatively estimated that effective telerobotics systems can increase the productivity of D&D remote operations by 10 to 30 percent. If only 10percent of the projected D&D projects involve remote operations, telerobotic savings enabled through the RTSA could be in the range from tens of millions to hundreds of millions in dollars.

RTSA will be a collection of software processes running on a computer in the operator's console and linked to physical devices on the remote worksystem. It will be organized into modules that provide a full spectrum of options to the operator for the fast and efficient creation of task space 3-D models.

The RTSA combines laser and stereo imaging, human-interactive modeling, and semiautomatic object recognition to build a 3-D model of the work zone in which a robot system is operating. In future telerobotic worksystems, RTSA results will be accessed by automatic collision checking and motion planning routines to automate subtask execution.

Status and Accomplishments: The Phase I draft Topical Report has been received. The preliminary results of this work show that the benefit of the Human Interactive Stereo and Semi-Autonomous scene analyses can be practically combined. The goals of the first phase are accomplished. A comprehensive design that has emphasized human interaction and human factors engineering principles has been completed. RTSA is a human interactive system that allows a remote operator to direct the construction of 3-D geometrical description of the task objects (e.g., pipes, valves, tanks, etc.).

Current Reporting Period Activities: A laboratory test demonstration was performed on September 16, 1999. The test involved a number of representatives from the Sandia National Laboratory, Oak Ridge National Laboratory, Idaho National Engineering and Environmental Laboratory, the University of Michigan, Savannah River Technology Center, Albuquerque Operations Office, U.S. Department of Energy/ Headquarters-EM, and the National Energy Technology Laboratory. The key objective in the development of the RTSA was to use the earlier work in task space scene analysis as a foundation for the development of an in-situ geometrical modeling system. This system is a practical tool that typical remote equipment operators could use comfortably. The test results shows that the current RTSA design achieves this important goal. Initial time results indicated that RTSA has the ability to construct models of a task space scene analysis layer on the order of minutes. The subtask time fits within the subtask execution operation cycle. Future work will involve the implementation and detailed evaluation of a complete RTSA system. All of the program will be executed on PC workstations with NT operating systems. Tests will be performed on several task mock-ups with multiple subjects and trials at the Remote Technology Assessment Facility at the Oak Ridge national Laboratory. In addition, the RTSA system will be integrated with the Dual Arm Work Platform to achieve a comprehensive and working telerobotic system.

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Integrated D&D Decision Analysis Tool

Objective and Scope: The objectives of this work are to develop a computer-based Survey Module, update the existing computer-based Decontamination and Decommissioning Technology Database Module, integrate the Survey Module and the D&D Technology Module, and distribute the integrated software. FedTech, Arrey Industries, NES, and Research Triangle Institute have teamed to accomplish this effort. The existing D&D Technology Database Module being updated under this task was developed under a previous contract with Arrey Industries, NES, NEXI and Research Triangle Institute. The Survey Module will be able to cost effectively assist in preparation and execution of plans for initial facility surveys, operational surveys during D&D work, and final facility release surveys. The Survey Module will estimate the budget, schedule, labor, radiation dose, waste generation, and equipment requirements to perform these surveys along with defining the number and location of survey points and recommended survey instruments. The Survey

Module will integrate the collection, storage, and reporting of survey data. The effort was estimated to be complete by December 31, 1998.

Current Reporting Period Activities: No activity.

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Modular Manipulator for Robotic Applications

Objective and Scope: This project focuses on the needs of Automated Plutonium Processing (APP) tasks that involve the manipulation of plutonium containers and the transfer of their contents. Specific challenges of APP gloveboxes include restrictive entry ports, confined workspace, limited maintenance access and destructive plutonium particulates, which make this task virtually impossible to automate with existing technology.

In order for automation systems to be successful within DOE facilities, they must provide maximum functionality, flexibility, ease of use, and reliability, while facilitating the rapid deployment of each custom system. This work concentrates on in-depth design and deployment of self-contained actuator modules, which shall be used to construct a robotic manipulator tailored for APP tasks. A human-scale manipulator will be built from two sizes of DISC Actuator and will replace existing human labor within plutonium gloveboxes. The modular nature of ARM Automation's technology readily enables installation and maintenance of automation within "hot" boxes.

Status and Accomplishments: A survey of the state-of-the-art modular manipulators design is completed. This survey addresses modular manipulators developed inside government laboratories, universities, and private industry for such applications as space exploration or control research and commercially viable industrial applications. Based on this study, it is possible to define the requirements of one manipulator system that can be used to conduct automated transfer operations within plutonium gloveboxes and some D&D applications.

Current Reporting Period Activities: The actuator modules, controllers and supporting equipment have been designed, built and are currently undergoing performance testing and debugging at the module level. Work is now underway to construct a glove box mock-up that will allow preliminary testing of this in-house demonstration manipulator.

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3.0 Programmatic Structure and Organization

Within the Environmental Management (EM) organization, the Office of Science and Technology (EM-50), formerly the Office of Technology Development, has the overall responsibility to develop and demonstrate technologies and systems to meet DOE's needs for environmental restoration and waste management. The office works closely with the EM Offices of Waste Management (EM-30), Environmental Restoration (EM-40), and Nuclear Materials and Facilities Stabilization (EM-60) in identifying, developing, demonstrating,and deploying innovative, cost-effective technologies and systems. Activities within EM-50 include research, development, demonstration, testing, and evaluation (RDDT&E); technology integration; technology transfer; and program support.

Program Structure

To focus DOE efforts on the most urgent needs, EM-50 has established four focus areas that address DOE's most pressing problems:

- Deactivation and Decommissioning (D&D)
- High-Level Waste Tank Remediation
- Mixed Waste Characterization, Treatment, and Disposal
- Subsurface Contaminants Containment and Remediation

In addition, EM-50 has established three crosscutting technology areas that conduct efforts where technology needs and targets are relevant to more than one focus area. The crosscutting areas are:

- Characterization, Monitoring, and Sensor Technology (CMST)
- Efficient Separations and Processing (ESP)
- Robotics

The Industry Program conducts competitively selected activities that involve the private sector in developing, demonstrating, and implementing improved technologies that address the needs of the focus areas and the crosscutting areas.

The result of this structure of programs is that the D&D Focus Area is positioned to support those research areas defined as highest priority by EM-50 and DOE customers.

The Role of NETL

The Federal Energy Technology Center, with physical sites in both Pittsburgh, Pennsylvania and Morgantown, West Virginia, was redesignated by U.S. Secretary of Energy Bill Richardson, as the National Energy Technology Laboratory (NETL). As the 15th national laboratory, NETL becomes part of the national laboratory research system. This is the largest research system of its kind in the world with more than 30,000 engineers and scientists conducting research and research and leading-edge experiments. As part of this system, the new National Energy Technology Laboratory will join Argonne National Laboratory (Illinois); Brookhaven National Laboratory (New York); Lawrence Berkeley National Laboratory (California); Fermi National Accelerator Laboratory (Illinois); Idaho National Engineering & Environmental Laboratory (Idaho); Lawrence Livermore National Laboratory (California); Los Alamos National Laboratory (New Mexico); National Renewable Energy Laboratory (Colorado); Oak Ridge National Laboratory (Tennessee); Pacific Northwest National Laboratory (Washington); and Sandia National Laboratories (New Mexico and California).

"It's time we elevate the profile and prestige of this world-class facility, which has been helping solve energy and environmental problems for more than 50 years,"

Bill Richardson, U.S. Secretary of Energy, National Energy Technology Laboratory Dedication Ceremony

Rita A. Bajura, NETL Director, a career federal executive with more than 18 years experience in government-industry energy partnerships, continues in her leadership position as head of the single management team that serves both physical sites with a combined working force of more than 530 federal scientists, engineers, and administrative staff. NETL is responsible for nearly 600 research projects; most involving the development of advanced fossil fuel technologies.

In addition to the new national laboratory's core capabilities, Secretary Richardson announced that a newly created Center for Advanced Natural Gas Studies, would be an integral part of NETL's research endowment.

Senator Robert C. Byrd, (WV) remarked in the course of the dedication that, "Much of

the laboratory's work is dedicated to the worthy goal of developing innovative, clean and efficient technologies that will allow our nation to meet its growing energy needs. As the nation's newest national laboratory, it will continue to help light a pathway for a new era of energy use that will ensure a comfortable standard of living for our children and our children's children."

NETL also manages a significant portion of the technology development needed to clean up sites in the government's nuclear weapons complex. In February 1995, the then Morgantown Energy Technology Center was selected by EM-50 to be the implementing organization for the D&D Focus Area. As such, it brought the experience gained from being the implementing organization for the Industry Program, which competitively selects industrial R&D performers through Research Opportunity Announcements (ROAs) and Program Research and Development Announcements (PRDAs). As the lead organization for D&D implementation, NETL is responsible for the planning, monitoring, and evaluating RDDT&E projects to meet the requirements of EM-50 and its customers in EM-30, EM-40, and EM-60.

Stakeholder Feedback

The stakeholders in the D&D Focus Area include DOE headquarters; DOE operations offices; DOE sites and their operating contractors; D&D technology developers and users in the private sector; federal, state, and local regulators; and the communities around affected DOE facilities. These stakeholders have been providing input to focus area planning and implementation; program contacts are provided on the first page of this report.

4.0 Background

The D&D Focus Area was established to develop and demonstrate improved technologies and systems that could solve customer-identified needs to characterize, deactivate, survey and maintain, decontaminate, dismantle, and dispose of or recycle DOE surplus facilities and their contents. The mission also includes facilitating the acceptance, approval, transfer, commercialization, deployment, and implementation of these technologies and systems.

These technologies are needed to address the pressing needs of deactivating more than 7000 contaminated buildings and decommissioning more than 700 buildings. In addition, material disposition is required for over 600,000 tons of metal and 23 million cubic meters of concrete in contaminated buildings and for 400,000 tons of metal currently in scrap piles. The major drivers for this focus area are the high safety and health risks associated with working in aged and contaminated facilities and the high costs associated with facility deactivation, surveillance, and maintenance using currently available baseline technologies.

D&D Focus Area Strategy

Subsequent to the selection of NETL as the lead organization for the D&D Focus Area, a program review of all FY95 projects was held in May 1995. Based on this and other recent program reviews, as well as the general requirement for fiscal constraint throughout, the following strategies were developed:

Programmatic Strategy

- Focus D&D technology development program on large-scale demonstrations emphasizing full-scale demonstrations using a suite of improved technologies.
- Demonstrate technologies only through large-scale demonstrations.
- Focus on technologies that are identified as high priority by customers, that have wide applicability, and that have a commitment to be considered for use by customers.
- Emphasize demonstration and deployment of private-sector technologies.

Technical Strategy

In the near term, emphasize technologies to effectively support:

- deactivation of facilities,
- decontamination of surfaces,
- reuse of bulk contaminated materials,and
- application of remotely operated dismantlement systems

In the middle term, emphasize technologies to effectively support:

- applications of remote surveillance systems,
- characterization of volumetrically contaminated materials,
- decontamination of bulk materials, and
- adoption of release standards for bulk contaminated materials.

Large-Scale Demonstrations

A cornerstone of the D&D Focus Area is its series of large-scale demonstration and deployment projects. The LSDDPs demonstrate innovative and improved D&D technologies at full scale, side by side with existing commercial technologies. The intent is to compare benefits from using a suite of improved and innovative D&D technologies against those associated with baseline D&D technologies. This approach provides an opportunity to test improved and innovative D&D technologies at a scale that will provide meaningful cost and performance information to the potential end-users of the technology.

5.0 Upcoming Events

The following conferences and workshops may be of interest to those with a stake in D&D cleanup activities.

February 2000

Waste Management 2000

Tucson, Arizona

February 27–March 2, 2000

www.wmsym.org/wm2000/

March 2000

Deactivation and Decommissioning Focus Area Mid-Year Review

March 28–30, 2000

Morgantown, West Virginia

(304) 285-4715

June 2000

IDS 2000—International Decommissioning Symposium

U.S. Department of Energy

Knoxville, Tennessee

June 12–16, 2000

www.ids2000.org

September 2000

Spectrum 2000

Chattanooga, Tennessee

September 24–28, 2000